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The Electrical Experimenter

POPULAR ELECTRICAL NEWS ILLUSTRATED



LARGEST CIRCULATION OF ANY ELECTRICAL PUBLICATION

WIRELESS AND AEROPLANES AID EUROPEAN "GUN-SPOTTERS."

(Continued from page 469)

a hill is a common occurrence on many of the battle fronts of Europe, and it is one of the standard exercises proscribed for the artillerymen of the United States Army.

As aeroplane radio sets have been greatly improved since the start of the present European war, it is now feasible for aeroplanes to maintain reliable radiocommunication over distances of forty to fifty miles. Some of these wireless sets operate on batteries, but the majority of them are designed to be excited from a small dynamo driven by the aeroplane engine. Aeroplane radio sets of American design are being turned out which do not weigh above fifteen to twenty pounds. Specially designed receiving sets are supplied for aviators, combining a leather helmet with the sensitive telephone receivers in-built to form an integral part of the entire head-gear. The antenna on aeroplanes has to be especially well insulated and many freak arrangements of the aerial conductors are to be seen. A single wire depending downward from an automatic take-up reel is extensively favored. In other cases the antenna is spread over the length and breadth of the machine, and suitably supported so as to be clear of grounding on the metal parts of the aeroplane frame and engine.

LIGHTNING MADE TO ORDER.

(Continued from page 474)

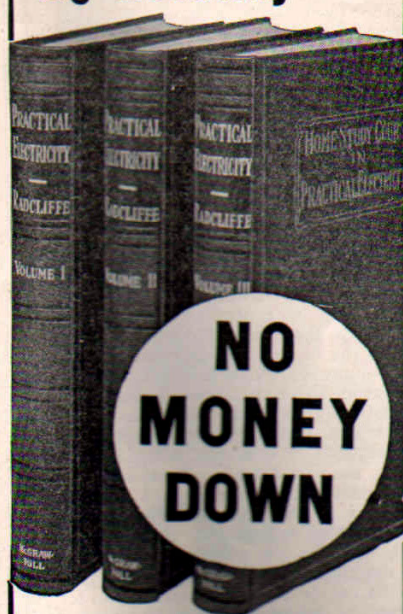
volts and a frequency of one hundred thousand per second! The flame-like discharge measures sixty-five feet across. This experiment was performed for the purpose of showing how the nitrogen of the atmosphere could be made to combine with the oxygen. The large wire cage measured 20 feet in diameter and 30 feet in height. This is not the actual coil which is excited by the primary of the Tesla transformer, but a separate helix which is attuned to a certain frequency of the secondary of the transformer. This is apparent by noting the large circular fence-like wall in the rear, which measures 60 feet in diameter and which is wound full with heavy copper wire.

The primary is carefully imbedded in the ground and connected with the regular oscillating circuit, comprising high tension oil condensers and the inductance incorporated in the primary of the Tesla transformer, also a spark discharger. In all these experiments the primary of the low tension transformer was excited with 300 kilowatts of electrical energy.

A very striking experiment showing the emission of an electrical discharge from a large sphere is shown in Fig. 2. The ball has a surface of twenty square feet which represents a large reservoir of electricity. The inverted circular pan underneath with sharp rim has an opening thru which the electricity can escape before filling the reservoir. The quantity of electricity liberated is so enormous that, although most of it escapes thru the rim of the pan or opening provided, the ball of the reservoir is nevertheless alternately emptied and filled to overflowing, as is evident from the discharge escaping on the top of the ball.

The coil shown in Fig. 3 creates an alternative movement of electricity from the earth into a large reservoir and back, at the rate of one hundred thousand pulsations per second. The adjustments were such that the reservoir fills and bursts at each alternation just at the moment when the electrical pressure reaches the maximum. The discharge escapes with a deafening noise, striking an unconnected coil twenty-two feet away, and creating such a disturbance of electricity in the earth, that heavy

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sparks an inch long were drawn from the water main at a distance of three hundred feet from the laboratory.

One very interesting experiment conducted by Dr. Tesla showed how it is possible to tune several coils to different frequencies with respect to the fundamental frequency generated by the main exciting coil. A photograph showing this experiment is reproduced at Fig. 4. The large coil on the right, discharging strongly, is tuned to the fundamental vibration which is fifty thousand cycles per second; the two larger vertical coils to twice that number; the smaller coils, wound with white wire, to four times that number and the remaining small coils to higher harmonics. The vibrations produced by the oscillator were so intense that they affected perceptibly a small coil tuned to the twenty-sixth harmonic above the fundamental.

The scientific world is keeping its eyes peeled for the next epochal movement in the problem of transmitting energy *via wireless*. And the world expects Dr. Nikola Tesla to do this.

UNCLE SAM'S NEW 40-MILE AN HOUR "ELECTRIC" BATTLE-CRUISER.

(Continued from page 479)

spray burners, as compared to the bulky Scotch boilers as installed on the Cunard liner, the *Lusitania*. The *Lusitania* developed 70,000 H.P. maximum from her power plant, with a resultant speed of somewhat over 25 knots per hour. This vessel measured 790 feet in length with a 98 foot beam.

Not only have the technicians of Uncle Sam's Naval Construction Board evolved something startling in the form of a wonderfully fast battle-cruiser, but they will carry something entirely new in heavy ordnance.

The big gun armament of these battle-cruisers will comprise eight 16 inch, 45 caliber rifles of a new type but recently developed by the U.S. Navy. It is said to be the most powerful gun in the world, firing a 2,400 pound shell with an initial velocity of 2,600 feet per second, or with an initial energy of 100,000 foot-tons.

Hence, when the officer in command presses an electric button that discharges a salvo from this mighty fighter of the seas, there will be represented a force of 800,000 foot tons, from the big gun battery alone—not to mention the secondary battery of six-inch and smaller caliber rifles, which will line the gun decks of the 900-foot armored hull. Thus, the primary battery of 16-inch rifles will develop sufficient energy to lift 2,000,000 pounds, 800 feet into the air. These large caliber rifles can be made to fire once every minute and faster when necessary. They will have about 25 degrees maximum elevation and a possible fighting range of approximately 30,000 yards.

It has been declared by naval experts that so remarkable is this new 16-inch gun, that under favorable conditions it would be possible to plant successive salvos on an enemy ship with accuracy, at a range of 25,000 yards.

The most important functions cared for by electricity on the modern battle-cruiser or dreadnought of the class above described are partly shown in the accompanying illustration with each particular part numbered, so that those interested can readily locate the most important general features of this truly wonderful craft. The key numbers start with the anchor hoist on the forward deck, just in front of the forward 16-inch gun turret. We will consider here simply a few of the more interesting and vital features involved in

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Lightning Made to Order

By Samuel Cohen

ONE of the most perplexing problems that scientists have attacked during recent years involved either the harnessing or imitation of the forces of Nature. Many of our greatest scientists in all parts of the globe have spent fabulous sums and years of patient study on such problems, but most of them have signally failed; a number of eminent scientists even claim that such conundrums will never be thoroughly solved.

This, however, appears, in our present day, to be highly doubtful. As early as 1890 Dr. Nikola Tesla undertook to solve the problem, and some years later succeeded in demonstrating to the world that it is quite possible to imitate certain natural dynamic forces on a scale of surprisingly vast magnitude.

Most of us know that *Lightning* is a natural electrical discharge taking place between two adjacent clouds, each having been charged with electricity of opposite polarity. As soon as they approach sufficiently close, the electric potential between them becomes so terrific that the air strata between is ruptured, thus producing a vivid spark, followed by thunder, which is caused by the sudden rush of air into the evacuated space produced by the electric discharge. Lightning may be caused also by a discharge taking place between a cloud and the earth. The process by which the clouds are electrically charged is still a mystery, and we must wait until some future genius will explain to us the exact

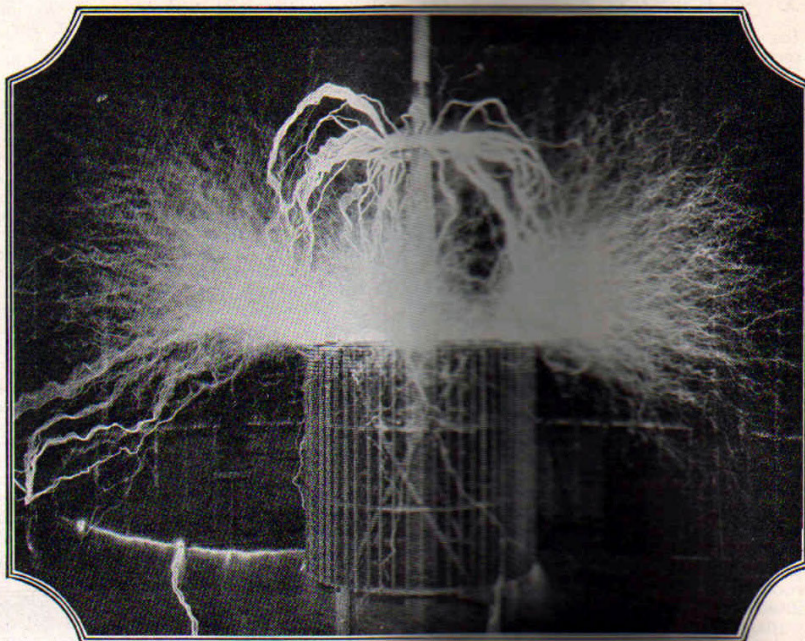


Fig. 1. The Wonderful Tesla, 300 K.W. High-Frequency Oscillator Coil in Full Activity, Discharging Sparks Like Veritable Bolts of Thor and Measuring 65 Feet Across.

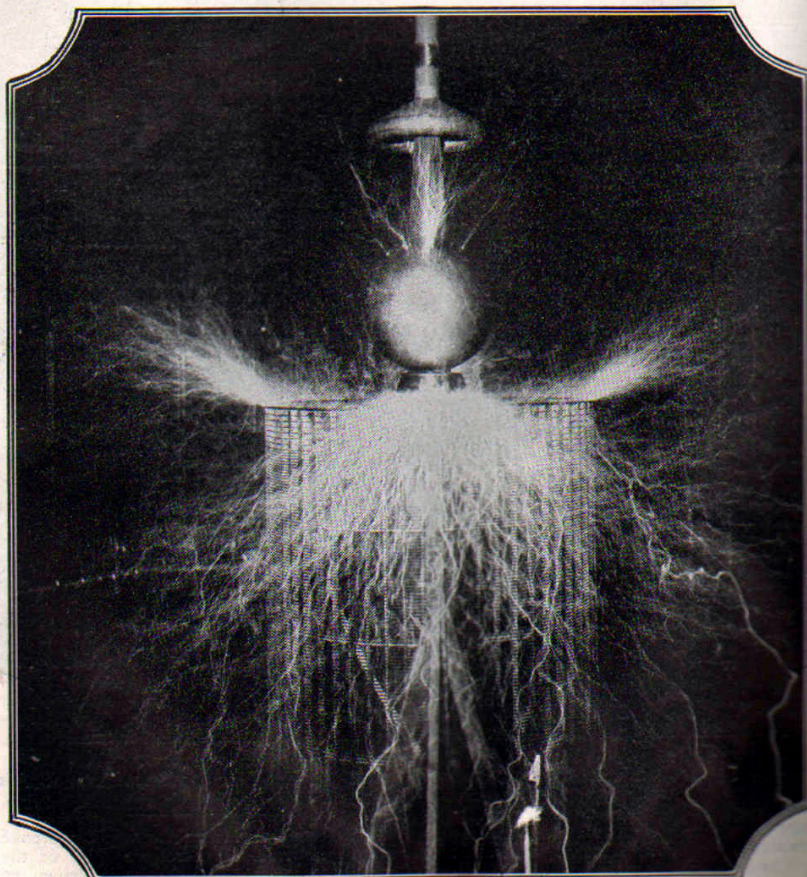


Fig. 2. A Close View of the Tesla Coil and Massive Metal Ball Which Acts as a Reservoir for the Electric Charges.

phenomena that takes place in the upper atmosphere, where such electrical disturbances take place.

Dr. Nikola Tesla, who is perhaps the greatest living authority on alternating currents of both high and low frequency, has performed some of the most marvelous experiments ever dreamed of with high potential, high frequency currents. As early as 1890 this expert had produced electrical disturbances in his laboratory at Colorado Springs equal to the lightning produced by Nature. Although a number of years have elapsed since these experiments were conducted, not a single scientist or engineer has been able to produce such awe-inspiring, electrical performances as did Dr. Tesla. It is true that he is far ahead of his time in many of his inventions, yet he has ably demonstrated that it is possible to imitate some of Nature's secret forces. It should be noted that his sole purpose was not simply to imitate these forces, but he was performing certain experiments on the problem of radio transmission of electrical energy through space. The startling lightning effects here shown were produced during the course of these experiments.

During a recent interview the writer had with Dr. Tesla, the photographs herewith reproduced were kindly loaned to accompany this article. Two of these photos were never shown to the public before. Our front cover, painted by Mr. George Wall, is an exact reproduction in colors corresponding to Fig. 1. The man was seated near the apparatus solely for the purpose of showing the relative size of the high frequency oscillation coil. The photograph was obtained by double exposure; that is, the plate was exposed with the man, while the apparatus was not in operation; then he was removed and another exposure made of the sparks on the same plate, as it would not be very healthy for anyone to be there when the experiment is conducted.

In Fig. 1 we see the Tesla electric oscillator in full activity at twelve million
(Continued on page 533)

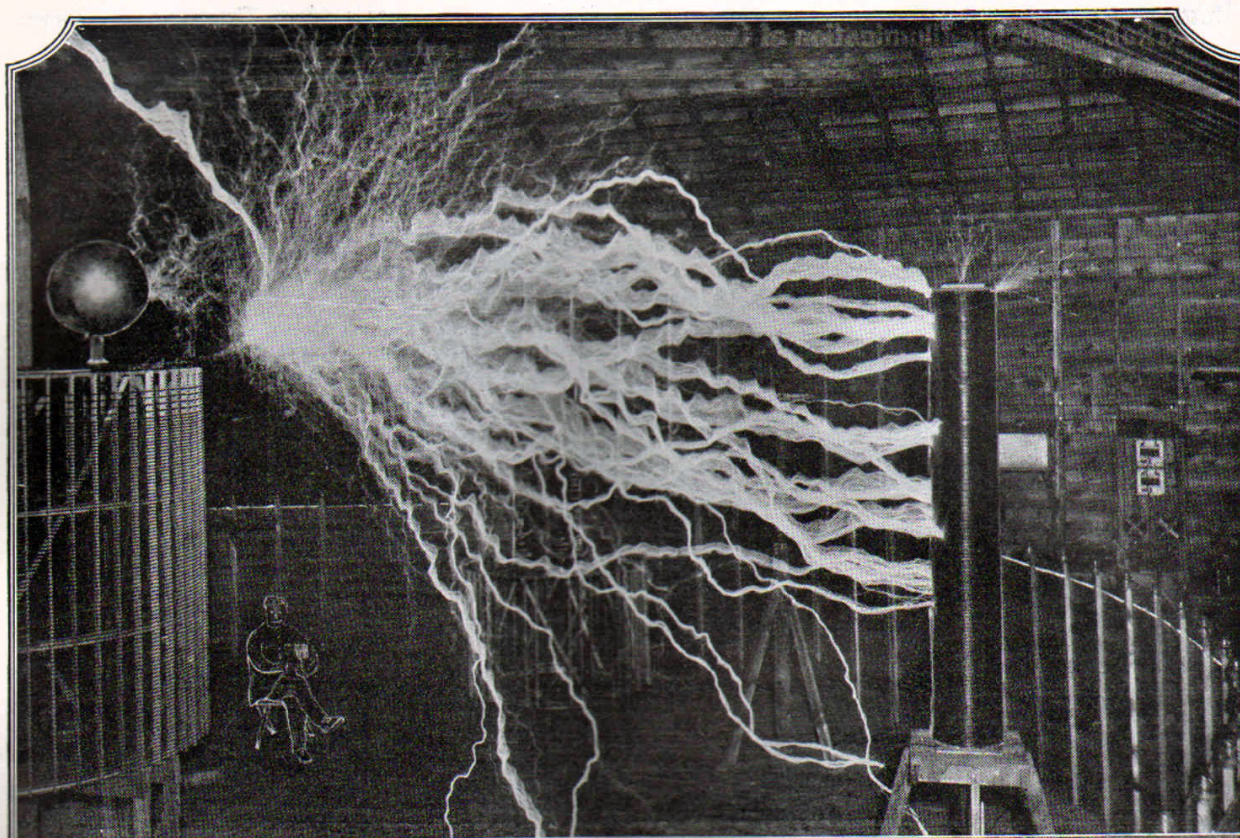
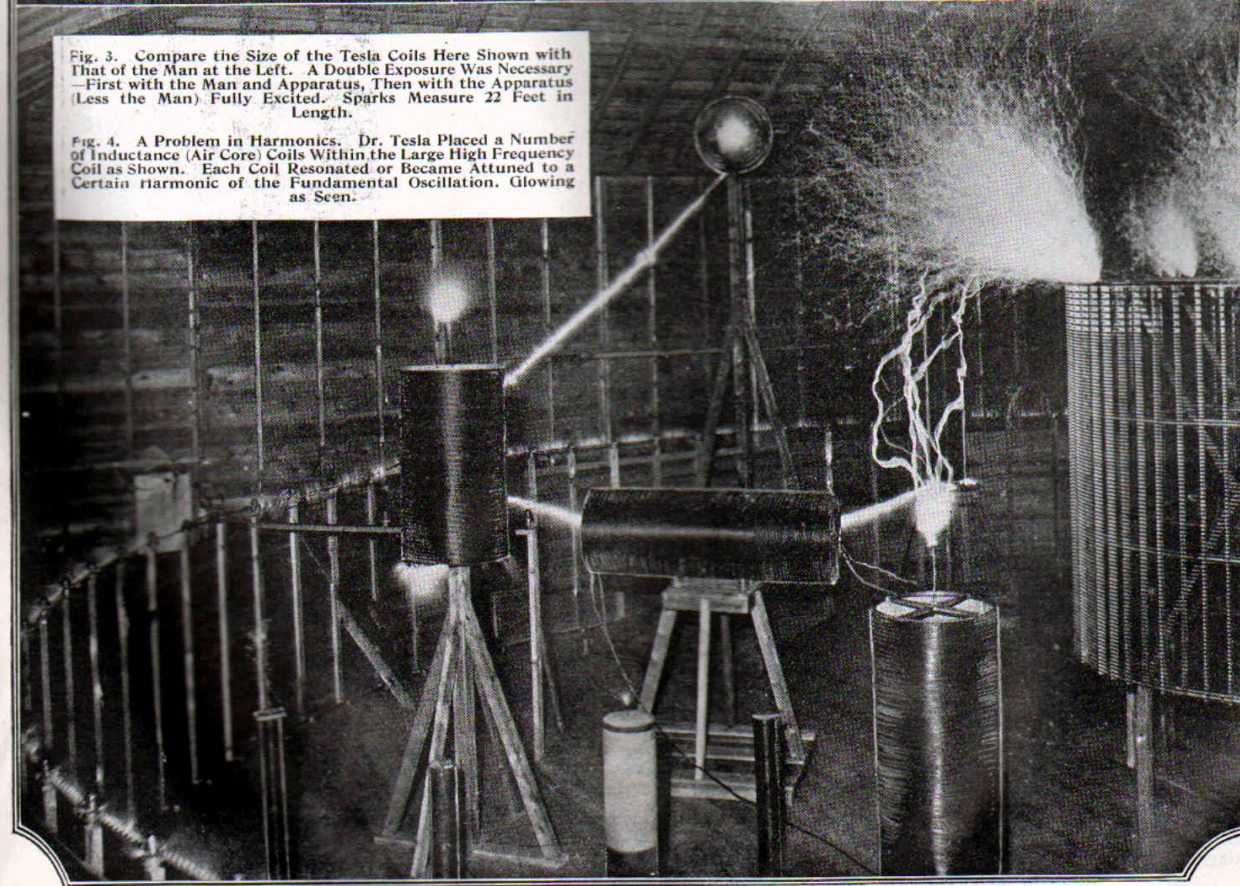


Fig. 3. Compare the Size of the Tesla Coils Here Shown with That of the Man at the Left. A Double Exposure Was Necessary—First with the Man and Apparatus, Then with the Apparatus (Less the Man) Fully Excited. Sparks Measure 22 Feet in Length.

Fig. 4. A Problem in Harmonics. Dr. Tesla Placed a Number of Inductance (Air Core) Coils Within the Large High Frequency Coil as Shown. Each Coil Resonated or Became Attuned to a Certain Harmonic of the Fundamental Oscillation, Glowing as Seen.



When Amateur Wireless Was Young

By H. de Scott

IT is a far cry from the modern wireless set rated at several hundred kilowatts and capable of hurtling forth its etheric waves over several thousand miles of space, to the small spark coil excited from a battery, with which Marconi and practically all other early radio experimenters worked.

Looking backward a few years the writer well remembers the early reports of Marconi's great successes in transmitting the now immortal 3 dots—representing the Morse code letter "S"—across the broad Atlantic from Cornwall, England, to Nova Scotia, Canada.

Interest in wireless matters ran high in those palmy days, when the amateur's aerial on the roof tops of lofty buildings was a rare sight indeed. But, so far as electrical experimenters went (we had no radio experimenters in those days), their interest might run high or at any old speed they liked, but one thing was certain: precious little information was available in book or magazine form for some years to come.

Around the year 1900 and in the next few years after that time, the author was residing at Trenton, New Jersey, and carried out a number of careful experiments on the old coherer type radio receiving sets. The first bit of information that he remembers reading was that endeavoring to explain how to construct a crude form of coherer. The patent specifications fairly teemed, of course, with very elaborate specifications on the construction of the improved Marconi type coherer, which was a very beautiful instrument, to be sure. But, in view of the fact that no air pumps were available and also as there was considerable doubt as to the size of the silver and nickel filings to be used in it and their quantity, little progress could be made with this data, at least at the outset.

However, a hand-book which appeared about this time, contained the quite startling information that if we were to take two round carbon, motor brushes, and insert them end to end in a glass (boiler gauge) tube, and provided, however, that we had a small quantity of clean, soft, iron filings between the plugs, that this somewhat doubtful-looking device would respond to the etheric waves sent out by a spark coil discharge. This information seemed quite wonderful indeed of itself, and many doubts were expressed by the writer's electrical friends as to whether such a junky contraption would really attempt to work; in fact, as I recollect it, most of the conclusions were that it distinctly would not! However, one of these coherers was constructed and the next thing was to try out a scheme of pure, etheric wave wireless transmission without any ground connection. A spark coil seemed absolutely necessary, but as none was available a medical or shocking coil was pressed into service. This coil was hooked up with about 10 dry cells, and after fiddling around with it and receiving innumerable and unexpected shocks, we finally managed to obtain about 1/32 of an inch spark at the secondary. We found it necessary to connect a tin-foil and waxed paper condenser across the vibrator in order to obtain this

spark, which the small served our purpose.

At last the psychological moment arrived and everything was tuned up. No polarized or other type of relay was at hand, wherefore an old burglar alarm magnet coil, wound to 20 ohms resistance, was rigged up with a light, pivoted iron armature, so that when attracted by the electromagnet it would close a secondary circuit containing a vibrating bell. This was supposed, according to all documentary evidence on hand, to shake or tap the coherer filings back into their original state.

After spending several exciting minutes in quieting down the obstreperous coherer (not to forget for one moment the *always lively* de-coherer), it was finally possible to realize and perceive that wireless transmission was actually taking place. Not over a vast distance, like Marconi's, by any means, as the coherer was not much over three feet from the spark gap. However, this distance was finally extended to about 75 feet, after longer brass rods had been placed on the receiving and transmitting instruments to serve as antenna and ground capacities. These were old, brass-plated,

ground connection for the receiving set was formed by pushing a large size screw-driver into the earth, to which a wire was attached from the instruments. Happy to relate, the coherer and de-coherer behaved quite intellectually for once, and the dots and dashes came tripping in, in apple-pie order, much to the bewilderment of several sidewalk bystanders.

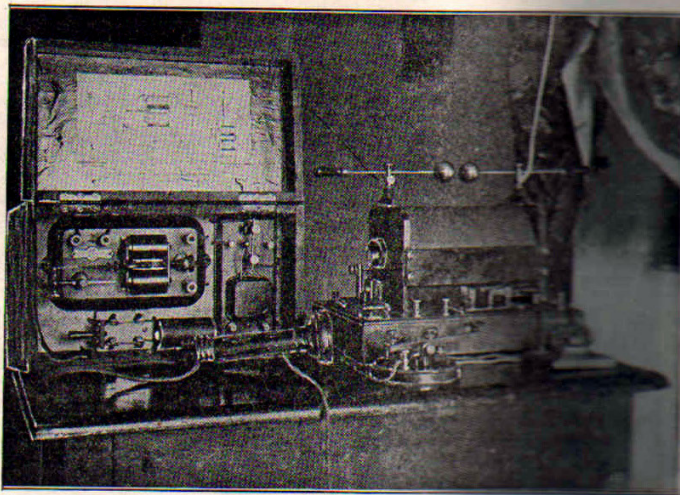
The instruments were working over a distance of about 1/2 mile on the outskirts of the city, but inversely, the crowd was not very small. A duly uniformed blue-coat, better known to radio amateurs as a "cop" hove in sight. After removing his hat and mopping his perspiring brow, occasioned by his recent sprint, he managed to bellow out: "Wat ya got there, Bobby?" You see I had made up this outfit quite complete, even to a wiring diagram of the instruments which was of course conspicuously shellacked in the lid of the cabinet, and to be sure it carried in large size and thoroughly legible Roman capitals the word *Wireless*. That was enough to get the "cop" thoroughly interested. In fact, after he had listened to the spasmodic rav-

ings and sputterings of the coherer and his twin-brother, the de-coherer, for a minute or two, he flatly refused to believe anything less than that the instrument was copying low-down racing reports *via wireless*. The climax of the matter was that he gave an imperative order to "close up that contraption and away with it." A little incident of this nature, however, did not deter the present scribe or his enthusiastic co-experimenters in the least. While experiments were being carried out with this crude but gradually improving radio experimental set, a number of rather amusing incidents happened from time to time.

One of these comes to mind vividly and happened thus: One day the spark coil and key were situated on the third floor of our domicile, while the innocent looking receiving cabinet

was placed on the parlor table, with its two brass curtain rods projecting from either side in their most scientific looking manner. A number of the neighbors were present on this occasion, including several electrical "sharpies," who, in their spare moments, dabbled now and then into the mysteries of the electrical art, even so far as to installing their own electric door bells. When everything was ready the spark coil was operated and true to nature the receptor responded promptly with a rat-a-tat-tat on the glass coherer tube for every spark. Those present were quite astounded at the uncanny performance and flatly refused to believe that any such mystical animal as a Hertzian Wave existed in the universe. To cap the climax, one of them finally suggested that we close all of the hall doors on every floor, as he felt sure that the messages came down the stairs to each floor and managed, somehow or other, to enter each door, so as to propagate themselves in a direction certain to reach the ever faithful receiving instruments. And so it went, much in accordance with that golden proverb—"Where Ignorance is Bliss 'tis Folly to be Wise."

Shortly after these experiences the
(Continued on page 537)



A Relic of the Author's Early Radio Experimental Days. It Bears Plain Evidence to the Fact That There Was Such an "Animal" at Any Rate, Even Though Some of the Neighbors Swore It Was Nothing but a "Fake."

iron curtain rods "swiped" from the kitchen window when mother was out to the corner grocery.

After several months of experimenting with about one thousand and one (including the famous "57") kinds of filing mixtures, containing all the know nothings and some that were apparently unknown, the writer and his associates finally achieved a certain measure of success. A piece of No. 14 B.&S. gauge, rubber covered copper conductor was suspended on a bamboo fishing pole secured to the edge of the roof; the lower end of this crude antenna was taken in through a porcelain tube in the first floor window sash. A 2-inch spark coil, which the "general staff" had managed to design and construct by this time, was connected up to the water pipe and the aerial. The writer arranged to have one of the family close the key now and then (mostly then), so as to send out waves from the improved antenna while he called forth with the *trick box*, containing the receiving instruments in order to test the working range. For a receiving antenna, a piece of No. 14 enameled covered magnet wire was utilized, suspending it from a 10-foot clothes-line prop. The

JAMES CLERK MAXWELL.

(Continued from page 471)
had taught in London only eight years when the state of his health became such as to force his retirement to his country estate in Scotland. Somewhat improved by his stay there, he became professor of experimental physics at Cambridge, in 1871. Only eight years later he died at the age of forty-eight.

At the International Electrical Congress, held in Paris in 1900, the memory of Maxwell was honored in giving his name to the unit of flux in a magnetic circuit—this unit corresponding to the ampere in electrical circuits.

WHEN AMATEUR WIRELESS WAS YOUNG.

(Continued from page 488)
scene of ye scribe's activities shifted to the city of brotherly love, Philadelphia. Here, after his miscellaneous "junk" and other paraphernalia had been ensconced in one of the famous (or is it infamous?) old boarding houses, that line Spruce Street, many wild dreams presented themselves to his imagination. One of the most pertinent of these was, that no longer would the old shellacked, two by nothing receiving cabinet suffice. Nothing to it—it must go. And it did, giving way to a most wonderful and fearful receiving "set." To begin with, this was to be a real outfit; one of those affairs that caused even your friends to throw up their hands and exclaim in wonder "What's this for?" and "What's that for?" and "Why do you have to use this?" and so on, *ad infinitum*, for about half an hour. By this time, after having read a number of books on the subject, there were, of course, always some new ideas to be added or incorporated in the outfit. These ideas multiplied bewilderingly and threatened to even scare the writer in their enormity. Before long there were so many wires, switches, chokes, jiggers, shunts and condensers hooked up to the 5000 ohm, polarized relay and coherer, that it is really doubtful when a regular wireless wave of respectable power did manage to enter the aerial and ground terminal post on the handsome oak cabinet, whether it could find its way through the maze of apparatus.

This "set" was finally, however, tuned up in good shape and gave excellent satisfaction. The two-inch spark coil was usefully employed in giving demonstrations with it and two pieces of brass tubing about three feet long, served as aerial and ground, as most of the tests were made only through the wall between two rooms, or between the third floor and the first floor of the dwelling.

An amusing, albeit not very pleasant experience, comes to mind when on one occasion there was a lecture to be given with this set at one of the local high-schools. At the last moment the glass coherer tube cracked and all the precious gold, silver and nickel filings flew pell-mell over the edge of the table and on the carpet. This was a hopeless case indeed, for the moment; but, recollecting that not many blocks away there was a scientific instrument company who manufactured demonstration sets of radio-telegraphic apparatus, a call was made on them at once. To be sure, they would be only too glad to sell a filling for a coherer. After we had sworn by all the Holy Saints that our set was really one of their manufacture, and after waiting for about an hour for the arrival of the precious filings of unknown origin, they came to hand, and the bill nearly knocked off our hats. For they only wanted \$2.00 for each filling and there were two fillings in the envelope, which the clerk politely stated to be the minimum order for them which they would handle.

One more experience will be related and

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pened, and then some, in the ensuing month and a half during which the construction of the coil parts and particularly the secondary proceeded with all possible haste. Patience is a virtue, to be sure, but it has a doubtful and variable place in the vocabulary of the electrical experimenter. He no sooner starts to build an apparatus when he begins to anxiously long for the final moment when everything will be ready to throw in the switch and watch the results. The spark coil, which was to be an eight-inch one, got along famously until it came to winding the secondary pies, each of which consisted of several hundred turns of very fine silk covered magnet wire run through a molten paraffine wax bath, as they were wound on to the former.

Luckily, it was during the winter months that this exciting indoor sport took place, and though the author worked diligently at it, even to the extent of spending every evening and holiday on the job, it required well over a month until the 115th pie (God bless it) was finished. If you do not know what trouble is, then you simply have to try carrying out such an operation as this in someone else's home, yes, even in a boarding house. Paraffine wax is a very innocent looking commodity when it is solidified. But allow a fair-sized quantity of this important substance to be molten over a stove in a closed room and watch the results. Not only, an uncomfortable amount of smoke is produced, but there is a rancid odor emitted with an unholy decrement, which has a persistent affinity for all doors, cracks and other openings. The reader may judge for himself of the howls and kicks made by the other occupants of the house while these scientific operations proceeded with all due haste. This haste was not altogether and totally due to the natural desire to see the final results of the spark coil, nor to the black looks and ungrateful remarks of those who passed the laboratory door, but distinctly and very pertinently to the fact that nothing but a gas light was supposed to be used in this boudoir. Finances had to be stretched in those days to the utmost limit in order to pay for the silk covered wire and other gadgets which were to adorn this masterpiece.

A gas stove bill could not be countenanced for one moment; hence there was always intense excitement whenever someone knocked at the door, for at that psychological moment everything, including and not forgetting the Bunsen burner which heated the wax, had to be heaved post haste into the nearest bureau drawer or into the trunk, and the key turned. And, what was worse, we had to conjure up a face which personified innocence itself, particularly when the caller who had so politely knocked at the door happened to be Her Royal Highness—the Landlady, sniffing suspiciously over the land!

Yes, those were the palmy days—but never again. The wife wouldn't stand for it.

THE MARVELS OF MODERN PHYSICS.

(Continued from page 485)

ted, and on the strength of this a wonderful station was built on Long Island. Every reader of scientific periodicals is familiar with its picture and history. At present it is deserted, but Tesla is still working upon the subject. The problem, however, is as yet unsolved. We will not say it is impossible of solution, for do we not have real wireless transmission of power as an everyday occurrence in the ordinary transformer? Though there is no metallic connection between the primary and secondary coils, yet there is an immense transfer of power at only a slight loss. Notice how near the ideal conditions are, however. The distance is negligibly small, and even the

Electricity and Life

The Construction of High-Frequency Apparatus for Medical and Lecture Use.

By FREDERICK FINCH STRONG, M. D.

Lecturer on Electro-therapeutics, Tufts Medical School, Boston

(Second Article)

IN the March number of THE ELECTRICAL EXPERIMENTER the author pointed out that high-frequency currents, when properly tuned, acted as "Vital Boosters," increasing all the functions of the body and helping it to resist and

The author has interviewed a number of the more prominent authorities on medical electricity and they agree as to the vitalizing effects resulting from daily high frequency treatment.

Anyone who possesses a $\frac{1}{4}$ or $\frac{1}{2}$ K.W. wireless transformer, operating on 110 volt, 60 cycle A.C., can easily construct an efficient high-frequency outfit for medical or lecture use. The complete equipment includes a .01 microfarad glass plate condenser, Tesla coil, inductance, spark gap and electrodes.

The Tesla coil is made as follows: (Fig. 3) On a paper mailing tube $2\frac{1}{2}$ " diam. and 14" long wind 480 turns of No. 34 D.C.C. copper magnet wire. Set up the tube in the lathe, apply a coat of orange shellac, spin on the wire, apply a second coat of shellac and allow to dry thoroughly. The winding occupies twelve inches, leaving a margin of one inch on each end of the tube. Leads of light auto (ignition) cable are soldered to the ends of the winding. A strip of waxed, corrugated paper $1\frac{1}{2}$ " wide is wrapt around the center of the secondary tube and on this is wound the primary, consisting of four turns of heavy high tension auto cable, and thereby secured by tape; at least a foot of cable should project from each end of the winding to form the primary leads. Place the coil in a wax tight box made without nails and embed it in a mixture of four parts rosin and one part beeswax. It is safer to boil the coil for an hour in the insulating mixture before placing it in the box. Coils made in this way by the writer are still giving good service after fifteen years of use.

The greatest source of trouble in a medical high-frequency outfit is the spark gap; the one described below is the outcome of many years experiment. If properly

made it will run daily for months without deterioration. The spark takes place between two pieces of brass rod $1\frac{1}{4}$ " diam. and 36" long, turned and tapt as shown. The sparking surfaces are turned in angular grooves with a 60 degree tool. If

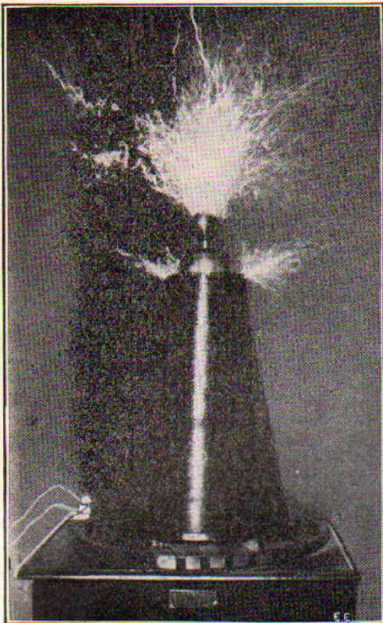


Fig. 1. View of the Strong Conical Oudin High Frequency Coil Delivering a Veritable Tree of Sparks Several Feet in Length.

throw off disease. This vitalizing effect is not due to the mere liberation of heat in the tissues, for it is produced by the very high-voltage ("Tesla") currents as well as by the heavy amperage ("D'Arsonval") currents from which the thermic effects are usually obtained.

When the writer demonstrated the first therapeutic Tesla Coil and the first Vacuum Electrode—in 1896 before a Boston Medical Society—and suggested that this method was destined to come into general use as a vitalizing agent, he was laughed at by his colleagues; yet to-day there is scarcely a well equipped physician's office in this country or in Europe that does not contain some form of therapeutic high-frequency apparatus. Even the barber-shops of the present time have their small "Violet Ray" outfits; and these are not by any means "fakes" for they produce real results, such as the relief of headache, neuralgia, skin diseases, et cetera.

Unlike other forms of electricity, these currents may be administered to patients with perfect safety. In twenty years' experience in electro-therapeutics the author has never known of harmful results from the use of Tesla Currents applied thru a vacuum electrode. The heavy amperage ("D'Arsonval") currents, owing to their deep thermic effects, should be used only under the direction of a physician. The writer is a firm believer in the use of Tesla currents in the home—if each member of the family could receive ten-minute daily treatments from a small high-frequency apparatus, the general standard of health would be greatly increased. This has been demonstrated in hundreds of cases.



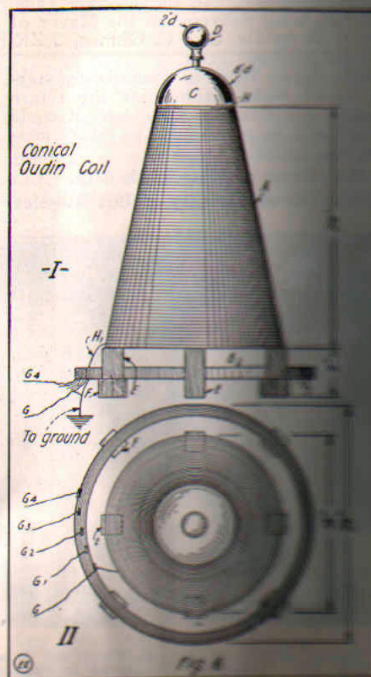
Fig. 2. Another View of the Strong High Frequency Coil Producing a Perfect Sheet of Sparking Connected to a Grounded Conductor. The Emitting Energy is but 1 Kilowatt.

your lathe has an automatic cross-feed you may set it to twenty turns to the inch, and turn a spiral groove instead of the angular rings. After finishing, the brass points are heavily silver plated and mounted in the usual manner as shown. (Fig. 4.) For currents over $\frac{1}{2}$ K.W., a plate of silver should be soldered to the brass before turning the grooves. This gap will also give greater efficiency in wireless work as compared with the usual stationary gap.

The connections for the various parts of the apparatus are shown in Fig. 5. An important feature is the use of an external inductance or tuning coil "d" in series with the Tesla coil. It consists of 32 turns of No. 8 bare copper wire, wound on a frame 8" diam. with $\frac{1}{4}$ " between turns. Edge-wire wound flat copper strip is better but more expensive. (d Fig. 8.) This coil when used in series with the Tesla primary enables us to tune the oscillating system in perfect resonance when the capacity of the patient's body is added to the Tesla terminal. Effects are produced which are impossible with any other method. The *horizontal High-frequency Effluve* or brush-discharge, so valuable in treating pulmonary disease, and which so few modern high-frequency machines can produce, is obtainable by the use of this series inductance. It may also be used, by short-circuiting the Tesla primary, as an auto-transformer from which may be derived heavy "D'Arsonval" and "diathermic" currents as described in the next article of this series.

For stage demonstration and public lecture work the writer employs a large high-frequency resonator which produces a tree-

(Continued on page 59)

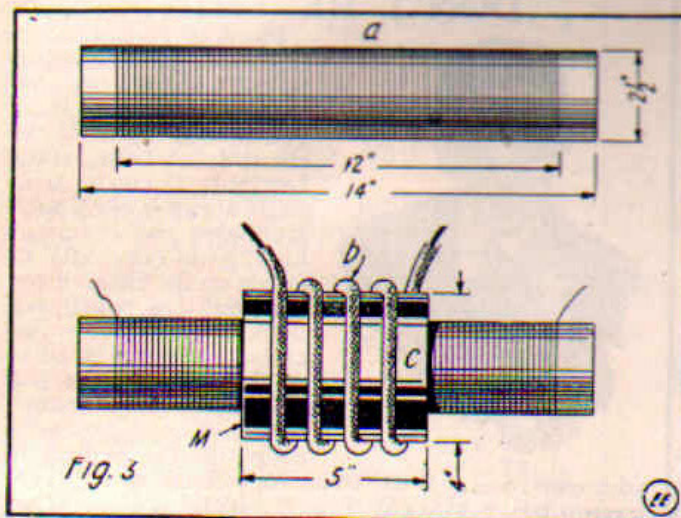


Details Are Given in This Article for Constructing a Reliable and Powerful Oudin or Tesla High Frequency Coil, Suitable for Physicians' Use. This Type of Coil is the Most Efficient Ever Designed.

ELECTRICITY AND LIFE.

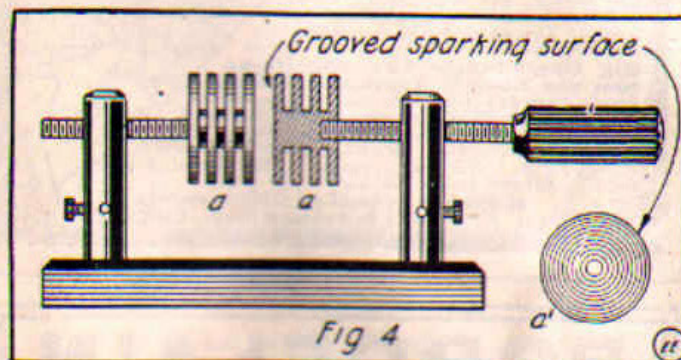
(Continued from page 24)

like discharge three feet in diameter (Fig. 1), and gives a heavy arc over two feet in



How Small Size Tesla Coil for Medical Treatment Is Built; "b" Is the Primary, "a" the Secondary.

length. (Fig. 2.) This shows remarkable efficiency when it is considered that the resonator is excited by a "Type E" transformer drawing only 1 K.W. and a con-



Unique Stationary Spark Gap Having Grooved Faces, as Devised by Dr. Strong.

denser of but .01 m.f. capacity. A small rotary spark gap is used such as is supplied by the E. I. Co. This result is made possible by the use of the separate inductance in series with the resonator primary (exactly the same as that described in connection with the therapeutic apparatus) (d Fig. 8). The writer believes his resonator gives the most spectacular discharge ever obtained from 1 kilowatt of energy.

Ordinary plate condensers are used, made from 8 x 10 inch negative glass, coated on both sides with tin-foil 6 x 8 inches (a Fig. 7). Six pairs of plates assembled into a

unit and boiled in wax give a capacity of .01 m.f. For safety it is better to employ four of these sections connected in pairs of .02 m.f. each (b Fig. 7). To run this resonator at full power for long periods of time it would be safer to use a series multiple condenser consisting of three sec-

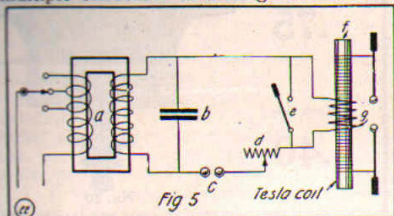


Fig 5 Connection Scheme for Tesla Coil "f-g," Shorting Switch "e," Tuning Inductance "d," Spark Gap "c," Condenser "b," and Step-up Exciting Transformer "a."

tions of .03 m.f. each in series. Such a condenser would contain 108-8 x 10 inch plates, and would be expensive, bulky and very heavy. For this reason the writer has found it much more convenient to use a single 12 plat. (.01 m.f.) condenser across the transformer secondary and to replace it when it punctures. The large resonator was operated for six months in lecture and experimental work before a condenser section broke down.

The cone for the secondary of the large resonator is of heavy paperboard and was built for the author by Bicknell and Fuller of Boston. Its dimensions (see Fig. 6) were suggested by Mr. Earle L. Ovington, the cone being similar in shape to those used by Mr. Ovington in the New York Electrical show several years ago. Any amateur can make a cone of this kind by superimposing strips of heavy paper, soaked in paste, over a wooden framework. The secondary winding consists of 400 turns of No. 27 D.C.C. copper magnet wire. Two parallel strands of wire are wound onto the cone, the adjacent turns in contact; after winding, one strand of wire is removed, leaving a space equal to the diameter of the wire between each of the 400 turns. The cone and winding is then treated with several coats of "Armialac" (ordinary shellac will not answer).

The primary consists of five turns of thin copper ribbon 1 inch wide, 3/8 inch paperboard strips being placed between the turns. The diameter of the coil is 24". When completed it is taped and rotated in a pan of melted wax until thoroughly impregnated. The terminal shown in the photographs is made from a large brass oil-can, the stem being removed and replaced by a 3" brass "bed-ball." The terminal is not attached to the cone but simply rests on its upper surface in contact with the end of the secondary wire. The primary and secondary are separately supported by

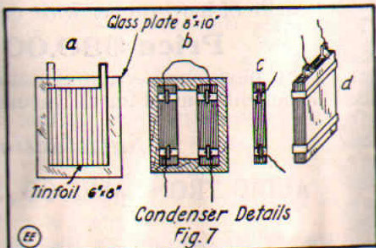


Fig 7 Details for Building High Tension Glass Plate Condenser to Be Connected in Tesla Coil Circuit.

square wooden blocks; the coupling is rather loose, the bottom of the resonator being at least two inches above the primary. The lower end of the secondary coil is attached to the inner primary terminal and grounded.



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Perfect resonance is obtained by varying the number of turns in the inductance coil in series with the primary. (Fig. 8.) This tuning system enables us to perform many brilliant experiments otherwise impossible, such as illuminating wires stretched across a lecture hall, lighting an inverted umbrella, etc. Some new and very spectacular experiments with this large resonator will be described and illustrated in an article in next month's "ELECTRICAL EXPERIMENTER," entitled "Methods of employing high-frequency currents in medical and lecture work."

The author is greatly indebted to Mr. O. K. Luscomb, for advice and assistance which made possible the successful construction of the large resonator.

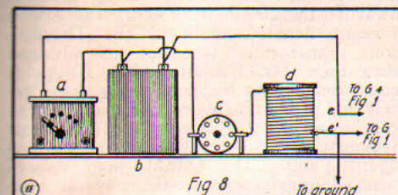


Fig 8 Method of Connecting Transformer, H. T. Condenser, Rotary Spark Gap and Tuning Inductance "d" to Large Outlin Coil.

At a recent lecture before the Belfast Association of Engineers Mr. A. W. Brown suggested the transmission of power generated from the tidal rise and fall of the water at Strangford Lough and Lough Neagh to Belfast. Thus, at Strangford Lough there are twenty square miles of water available, the spring tides have a rise of 14 1/2 feet and the neap tides a rise of 11 1/2 feet, with a range of 7 1/2 feet. About 20,000 horsepower could be developed for a period of two and one-half

THE WASHINGTON'S BIRTHDAY RELAY PRIZE WINNERS.

(Continued from page 23)

live in a state that has as much real earth in it as is blown into the air in some of our larger states during every wind storm!

These few think they are very important and if you don't do as they say, why the Government will close you up. They say "The Danger Signal is up." Did you ever hear of a good, red-blooded American Kid who could be bluffed? No! It is not in your make-up. The Government is only too anxious for you to perfect yourself in the art, and help it out by joining the "Radio Reserves."

PRIZES.

This is a stunner for one who would like to give everybody that helped a prize, but it can't be done, so I am going to ask the boys who acted as sending stations to consider that they are one of the family and help me by agreeing that the prizes should go to the boys who made the best records in receiving and delivery. The rest of the amateurs will be rewarded by having their names printed in this magazine, so that when you grow older and have a little one on each knee in front of the old log fire, some cold night, you may read to them about Daddy and what he did when he was a mere boy.

Before you all get busy reading about the prize winners, I want to call your attention to several hard workers who turned in the most complete reports, or "logs," of the relay, that the writer has ever had the privilege of reading.

Hoyt, of Hayward, California, 6 SI, who is also a prize winner, turned in the most complete report ever seen.

Stewart of St. Davids, Pennsylvania, 3 ZS, whom you all know as one of the hard hours, the power available varying from maximum to minimum every six hours.

You benefit by m

X-Ray Tubes for High Frequency Coils

By Dr. FREDERICK FINCH STRONG

Lecturer on Electro-therapeutics, Tufts Medical School, Boston

IN all the history of scientific achievement there has been perhaps no discovery of such a startling and revolutionary character as that of the X-Ray. The *Electron theory*, which forms the basis of the chemistry and physics of our New Age has been formulated almost en-

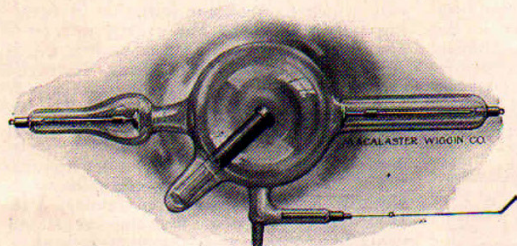
an atmosphere. He gave to the world the "Crookes tube," with which Lenard in 1894, proved the existence of the "Cathode rays," and from which in 1895, Roentgen accidentally discovered a new form of emitted energy which he tentatively called the "X-Ray."

We all recall the circumstances of this discovery. Roentgen was experimenting with a Crookes tube enveloped in an opaque cover, when he noticed a bright glow on a nearby card, coated with Platinum-Barium-Cyanid. The glow continued even when the uncoated surface of the card was presented to the tube, and further experiment showed that the interposition of the experimenter's hand between the covered tube and the fluorescent screen would cause a shadow-picture of the bones to appear upon the glowing surface.

The publication of Roentgen's discovery led investigators in all parts of the world to study the new phenomena. Static machines and Ruhmkorff induction coils were at first employed to excite the Crookes tubes; but the intensity of the re-

may be made in the fraction of a second.

For the general practitioner, the dentist and the amateur experimenter, however, the high-frequency apparatus is still the most convenient and inexpensive device for ex-



Standard Form of Single-Focus High Frequency X-Ray Tube. The First Powerful X-Ray Tubes Were Excited By a High Frequency Oscillator.

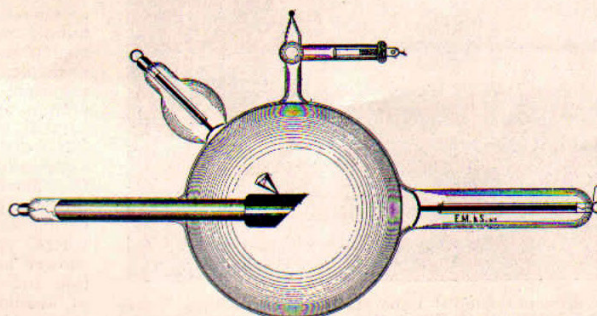
tirely from deduction made possible by the work of Roentgen and the Curies.

If we review the history of these discoveries we find that they have resulted from long series of researches dealing with the phenomena of electrical discharges in partial vacua.

The air pump was invented in 1650 by Otto von Guericke; by its use Sir W. Snow Harris, in 1834 was able to show that the spark-length of a given electrical machine increases in inverse ratio to the pressure of the gas thru which it passes. His tubes were exhausted to about one five-hundredth of an atmosphere, and the discharge took the form of a pencil of violet-pink light.

Geissler, in 1838, experimented with discharges in low vacua, and invented the beautiful tubes which bear his name. By improving the air-pump, he was able to withdraw all but one ten-thousandth of the original air from the glass tube, and change the color of the glow, in the electrified space from violet-pink to a pure white.

The invention of the mercury air-pump by Sprengel in 1865, made it possible for



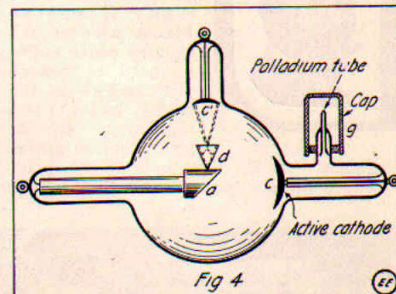
Commercial Form of a Second Type of Single-Focus High Frequency X-Ray Tube Shown Sectionally in Fig. 4. These Tubes Are Adapted to High Power Tesla or Oudin Coils.

sulting X-rays was not very great. In those days an induction coil giving a four-inch spark was regarded as exceedingly powerful. We know now that such an apparatus is entirely inadequate to the production of X-rays for any practical purpose.

Tesla and Elihu Thompson advocated high-frequency currents for X-ray generation, and in 1896 the Knott Apparatus Company of Boston designed the first practical commercial X-ray machine. It consisted of an open-core transformer, glass-plate condenser and Tesla coil, immersed in oil, and a rotary spark-gap not unlike those now used in Radio-telegraphy.

A few months later, the writer made the first practical high-frequency apparatus having solid insulation instead of oil, and suitable for therapeutic as well as X-ray work. The many types of high-frequency machines that are now made for physicians' use are but variations and improvements of this original apparatus.

At the present time the professional Roentgenologist uses almost exclusively powerful apparatus of the high-tension transformer type; the high-voltage, low-frequency, alternating current being rectified by a high-tension commutator operated by a synchronous motor. With such an apparatus and suitable X-ray tubes, a skiagram of the adult thorax or abdomen



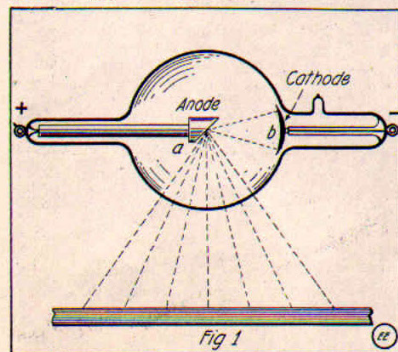
Special Form of X-Ray Tube of the Single-Focus Type, Fitted With Palladium Vacuum Regulator and Focussing Mirror "C", Also Copper Cone "d," for Dissipating Auxiliary Cathode Stream.

citing X-ray tubes, and produces results quite adequate to their respective needs.

The construction of an X-ray tube is familiar to all;—in its simplest form it consists of a Crookes tube (as shown in

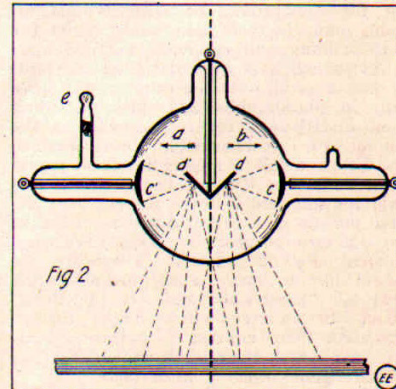
Fig. 1), containing an anode or target (a), faced with platinum or tungsten, and a concave aluminum cathode (b). A high-voltage, unidirectional current flowing thru the tube causes streams of electrons to pass from the cathode to the target, which is set at an angle of forty-five degrees to the axis of the tube. The electronic stream ("Cathode rays"), is reflected at right angles and part of the energy is transformed into X-rays, which emerge from the glass in a divergent cone, as shown. Such a tube is not suited for use with alternating or oscillating currents, as a double set of rays would be produced; this would tend to melt the aluminum cathode and cause the absorption of the residual gas in the tube so that it would soon be too "hard" to use.

This led Elihu Thompson, in 1896, to invent his "double-focus tube"; the con-



The Simple X-Ray Tube Contains an Anode or Target "a" and an Aluminum Cathode "b." The Cathodic Electron Bombardment of Target "a" Causes X-Rays to be Produced At Right Angles or Downward As Shown.

Sir William Crookes in 1878, to study electrical discharges in rarefied gases with pressures as low as one one-millionth of



The Original Thompson Double-Focus High Frequency X-Ray Tube Which Really Comprised Two Distinct Bulb Elements.

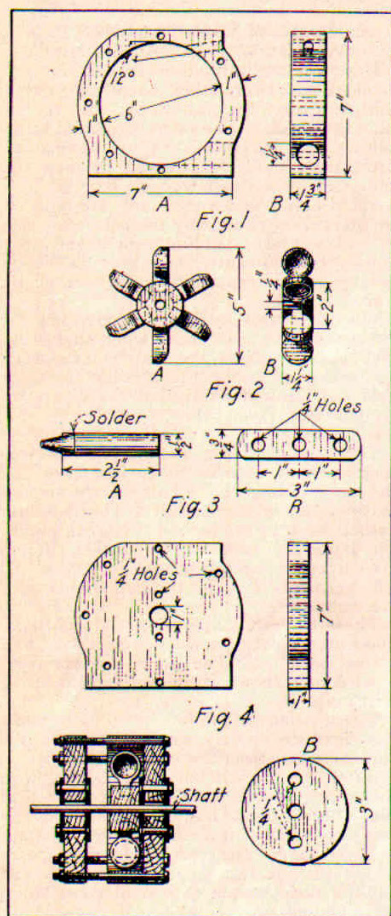
struction and operation of the Thompson double-focus tube is shown in Fig. 2.

(Continued on page 328)

A SMALL WATER MOTOR FOR DRIVING DYNAMOS.

By W. E. Leach.

A water motor, owing to the variety of uses it may be put to, will find ready call among experimenters. It is not at all difficult to construct and below I describe one



Construction Details for a Small Water Motor Which Will Prove Useful in Driving Dynamos or Other Light Machinery.

that I made and used successfully to drive a dynamo, sharpen tools, as a drill, and also as a small lathe.

The first thing to obtain is the materials. These consist briefly of the following:—1 piece 2" x 8" x 10" plank (hard wood), 2 pieces 1" x 8" x 10" board (pine), some 1/4" x 1/2" board (soft or hard wood)—7 5" x 3/16" bolts, 4 1 1/2" x 3/16" bolts, 1 piece brass tubing 1/2" in diameter, 2 1/2" long (for nozzle).

To begin with, cut a case from the piece of plank as shown in Fig. 1 A and B. Bore seven 1/4" holes thru this as shown. At the bottom bore a 1 1/2" hole for an outlet. Then at the top, bore a 1/2" hole about 12° to the horizontal; this is the inlet. The rotating section is made up as shown in Fig. 2 A and B. The vanes or paddles are cut from 1/2" boards and of dimensions shown. They are hollowed out at the ends and are set into an axle cut from a piece of hard wood 1 1/4" x 2" with a 1/4" hole thru the center.

To make the nozzle take the piece of brass tubing above mentioned and solder to it a cone shaped piece of tin as in Fig. 3—A. Now drive this into hole at top of case until its tip first comes to the inner edge.

Now for the sides, cut two pieces out of

1" pine as shown in Fig. 4. Bore 7 1/4" holes thru these to correspond to those in the case (Fig. 1). At the center bore a 1" hole, and about 1" away from the center in a perpendicular line, drill one 1/4" hole on each side of this as shown. Now make two plates 3" in diameter and 1/4" thick as shown in B (Fig. 4). Bore a 1/4" hole in the center and about 1" to either side bore another 1/4" hole. Make two plates of iron as in Fig. 3—B. Drill holes to correspond to those in the plates, Fig. 4—B.

Give all parts two coats of good water-resisting paint and when dry assemble as follows:—Place a plate (Fig. 4—B) on the outside of the sides, put a wad of packing soaked in oil in the 1" hole. Then place an iron strip (Fig. 3—B) on the inside of each side and bolt firmly together with two 1 1/2" x 3/16" bolts. Drive a shaft thru the rotating part. Insert one end of shaft thru one side and then place inside of case. Put the 7 5" x 3/16" bolts thru and fasten the other side together. (In setting up, if some pitch is placed between the sides and case it will prevent any leakage.) Connect the motor to any faucet by a rubber hose and it is ready for work. If all parts were smooth and bored and cut accurately, little trouble will present itself and the motor will go buzzing around at first connection.

X-RAY TUBES FOR HIGH-FREQUENCY COILS.

(Continued from page 309)

It is really a combination of two distinct tubes, as indicated by the heavy vertical dotted line. When the current passes in the direction of the arrow (b) X-rays are produced from the cathode and target (c and d) in the right-hand half of the tube; alternations in the opposite direction, indicated by the arrow (a), produce a stream of rays from the left half of the tube. This is the most efficient form of high-frequency X-ray tube, as it uses both sets of alternations. It is now practically obsolete, however, as it was found that the two sets of X-rays overlapped and produced double outlines in the skiagram.

At the present time there are two types of X-ray tubes made for use with high-frequency currents. The one shown in Fig. 3 has a target of heavy copper faced with tungsten, and is mounted opposite the active cathode (c); when the current flows in the opposite direction the electronic stream from the small cathode (c') becomes choked out and dispersed by the constricted glass neck (d), which acts, in a measure, as a valve, eliminating the inverse discharge.

Another type of modern high-frequency X-ray tube is shown in Fig. 4, in which the cathode rays from the small aluminum mirror (c') focus inside a small copper cone (d), in which they are converted into heat and take no part in the production of the X-rays.

Tubes of these types may be operated by the current from a Tesla coil or from an Oudin resonator. In a previous article in the May issue of the ELECTRICAL EXPERIMENTER the writer has given details for the construction of apparatus of both these types.

When the Tesla coil is used its terminals are connected to the two aluminum cathodes (c and c'); the Oudin coil has but one active terminal which should be connected to the active cathode (c); the small cathode (c') may be grounded, but this is not absolutely necessary.

X-ray tubes are spoken of as "hard" and "soft"—a "hard" tube is one which has been exhausted to a very high degree—(say, one-ten-millionth of an atmosphere)—a "soft" tube has a lower degree of

exhaustion (between one-five-hundred-thousandth and one-one-millionth of an atmosphere). More current is needed to operate a hard tube, but it gives deep penetration and works more quickly. The soft tube, on the other hand, produces strong contrasts in the skiagram or fluoroscope.

Tubes have a tendency to become hard by use, the trace of residual air or gas being gradually driven out thru the intermolecular spaces of the glass by the electronic bombardment. So it is necessary to provide the tube with some means for replacing these lost ions at intervals.

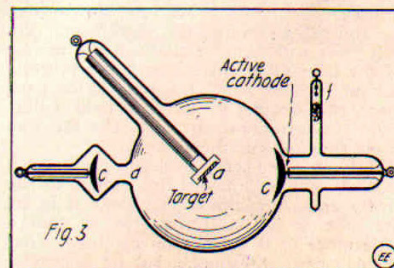
The first is of the thermic type and is now seldom used (see e, Fig. 2); it consists of a small bulb containing potassium chlorate sealed into the side of the X-ray tube. By heating this bulb with a match or spirit-lamp, a trace of oxygen is given off, which reduces the pressure in the tube to the required degree. The modern high-frequency tubes use the forms known as the "spark regulator" and the "osmotic regulator."

The first is the more common type and is shown in (f, Fig. 3). A platinum wire is sealed in the regulator tube which contains a gas-producing chemical, such as manganese dioxide, or sodium formate, f.

In practise a piece of E-shaped stiff brass wire set in a rubber handle is used to divert a portion of the current from the active terminal to the wire in the regulator; the heat from the current liberating the gas and softening the tube.

A regulator of the osmotic type is shown at (g, Fig. 4). It consists of an extremely small tube of metallic palladium sealed into the side of the X-ray bulb, the inner end of the metal tube being open while the outer end is closed. Ordinarily the tube is protected by a cylindrical glass cap. If the latter be removed, and the flame of a spirit-lamp be applied to the closed extremity of the palladium tube, hydrogen ions from the interior of the flame will be drawn thru the intermolecular spaces of the heated metal into the X-ray bulb.

Amateurs and physicians using X-ray outfits often desire to view considerable areas of the body simultaneously; this can be done only by using a large fluorescent screen and covering the X-ray tube with opaque material. Ordinary fluoroscopic screens are coated with barium-platinum-



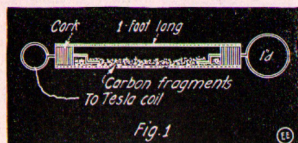
One Form of Commercial High-Frequency X-Ray Bulb of the Single-focus Type, Utilizing An Active Cathode "C". Also a Small Cut-off Cathode "C'". The Inverse Cathodic Stream from "C'" Is Choked Off and Dispersed by the Constricted Glass Neck "D", Which Acts As a Valve.

cyanid and cost about \$0.25 per sq. inch. A very good screen may, however, be easily made by evenly coating a sheet of white cardboard with a solution of sodium silicat and immediately sifting on it finely powdered calcium tungstat. Gently raise the screen on its edge and tap it to shake off the excess of tungstat; then allow to dry. A still simpler experimental screen may be made by painting a card several times with a strong solution of quinine bi-sulfate.

High Frequency Phenomena and Experiments

By FREDERICK VON LICHTENOW

EXPERIMENTAL electricity in its various phases has always held an irresistible fascination for me. Under its captivating influence I find myself experimenting thruout the year, whenever time allows this, ever

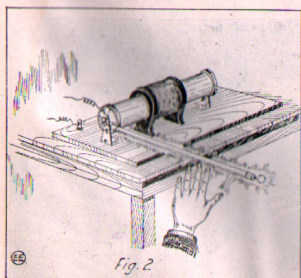


The High Frequency "Spark Tube"—It Comprises a Glass Tube Partially Filled with Powdered Carbon. It Is Charged by "Unipolar" Current from a Tesla Coil.

in search for the unknown trail leading to some new wonderland of electrical manifestations. This trail is exceedingly hard to find, not to speak of the wonderland beyond, in the hope of a "new discovery" The principles underlying the thousands of tried experiments are known to science; and in order to present something perfectly new, the principle involved must at the same time be a novel one. I have not succeeded that far, sorry to say, and the few experiments given here may be original only in the way in which they are offered. From a practical or mechanical standpoint they are worthless; in fact, they would cease to be experiments with the moment they could be put to a practical use.

EXPERIMENT No. 1.

A tube of glass about a foot long and one-half inch in diameter is filled with enough small fragments of carbon (those taken from an ordinary lead pencil or arc light carbon suffice) so that they cover its lower surface completely, when placed flat on the table. The openings at both ends of the tube are

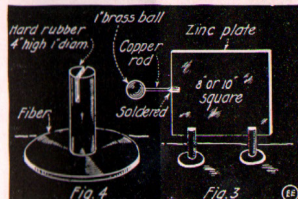


If the Extended Fingers Are Approached to the "Spark Tube," Fine Sparks Will Be Drawn Thru the Glass to the Hand. These Are Harmless, Owing to the Very High Frequency. The Experiment Works Best in the Dark.

plugged up with corks, thru the centers of which short ends of brass or copper wire are inserted in order to make connection with the carbon particles. The outward protruding ends are shaped into rings, preferably soldered at the joints, (see Fig. 1). The smaller ring connects to one secondary post of the Tesla coil, while the larger one supports, and at the same time "grounds," the tube on the table.

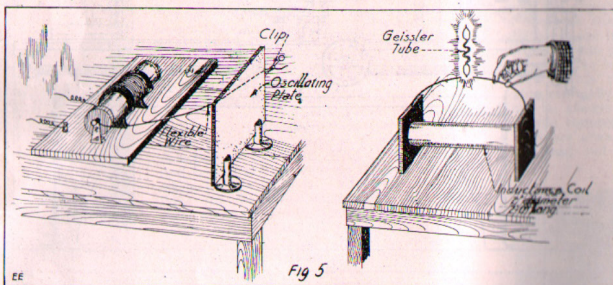
As indicated already unipolar current is employed. When the current passes, wonderfully blue-white sparks run in a steady stream over the carbon fragments, illuminating the whole tube, while the larger ring sends off a spray of violet light on its lower curve. Upon approaching the tube with the hand, fingers spread apart, violet streamers, accompanied by a sizzling noise, can be drawn thru the glass into each extended finger, (Fig. 2). The length of these streaming sparks depends naturally on the electrical output of the generating set used. With only a 1½ inch "Bulldog" spark coil and a standard "Electro" Tesla transformer of the same make, together with the proper condenser capacity and a spark gap provided with long, sharply pointed zinc electrodes, I was able to draw sparks one inch

power of the generating set regulates the distance between the oscillator and the inductance coil. With the aforementioned, comparatively small outfit, this distance was



An Interesting Tesla Current Experiment Can Be Made with the Aid of This Metal "Oscillator" Plate. It Is Charged by a Unipolar Current and Rests on Hard Rubber Insulators.

limited to a foot and a half on the outside. Upon the current being turned on and wires approached to within about ¼ inch, violet-colored sparks will pass between their points. If the wire on the further end is now grounded by holding it in one hand, the sparks will be increased to more than twice their former length. This experiment affords a very spectacular way of lighting Geissler and other vacuum tubes. The coil ends should, for best results, be constructed of some insulating material, or if made of wood this should be thoroughly coated with shellac, the same as the insulated wire windings.

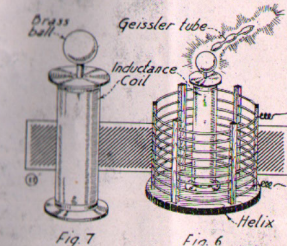


A Short Distance Away from the "Oscillator" Plate, Charged by a Unipolar Tesla Current, There Is Placed an Inductance Coil. The Current Induced in It Will Light up a Geissler Tube.

in length which were visible in a lighted room. However, the beauty of this experiment can be appreciated to the fullest in perfect darkness only, when the actual length of the sparks, which are really considerably longer, may be ascertained. To heighten the effect, the spark gap should be darkened also. I may add that the glass tube soon cracks under the electrical strain and has to be replaced by a new one.

EXPERIMENT No. 2

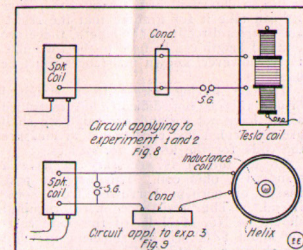
A flexible helix wire, having a clip on one end, is connected to one secondary binding post of the Tesla coil, while the clip engages in the copper rod attached to the oscillator. This latter consists of a plate of zinc 8 or 10 inches square and a heavy copper rod, carrying a 1 inch solid brass ball, brightly polished, on its end and soldered to it, (see Fig. 3.) Hard-rubber stands as shown in Fig. 4 support the oscillating plate and afford the proper insulation. In the plane of the waves oscillating from the sheet of zinc, a large inductance coil, about 2 feet long, 2 inches in diameter, and wound with a single layer of fine (No. 36 or 38 B. & S.) insulated magnet wire, is then placed. This coil has a binding post on either end, to which pieces of stout copper wire are fastened, and may be mounted on a separate table from the one holding the Tesla set (Fig. 5). Here again the



An Unusual "Oudin" Coil Is Made from a Helix and a Small Inductance Coil Built as Shown. The Latter Has Brass End Cheeks Which Help to Pick up Energy from the Charged Helix, with Which It Has No Connection. The Smaller Coil Measures 8¼ by 2½.

B. & S.) silk covered, magnet wire, thoroly coated with shellac. The brass ball proper has a diameter of two inches. Both coil ends consist of solid brass instead of some insulating material for the sake of other experiments, (Fig. 7).

If the helix is now connected up as shown in diagram, sparks may be taken off at the coil terminal, Geissler tubes lighted, etc., altho this coil is in no wise connected to the circuit, both coil and helix merely working under the principle of the Tesla transformer. In all these experiments it is imperative to have the connecting wires as



Diagrams Showing How the High Frequency Apparatus Is Connected for the Experiments Here Described.

short and straight as possible and also heavy besides. Both the rubber-covered copper cable and the insulated flexible stranded copper wire are entirely satisfactory in this respect.

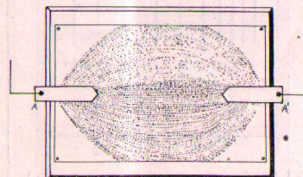
SHOWING FIELD OF STATIC CHARGE.

The following experiment to demonstrate the lines of force in a static charge can be performed by anyone having a Whims-hurst static machine, such as the E. I. Co. type.

First buy or prepare some powdered glass by grinding up a few old test tubes in an iron mortar and sifting thru a fine screen. Dry a 10 x 14 inch (size need not be exact) pine board thoroly and tack a sheet of smooth drawing paper on it.

Prepare two pointed tinfoil strips AA' about 8 inches apart on paper and connect with the two rods of the static machine. Draw the balls on the machine far enough apart to prevent a discharge. Drive off all moisture from the powdered glass by heating it and sprinkle a light layer over paper. When the static machine is started, tap the board very lightly and the glass particles will form in curved lines, similar to the lines formed by iron filings and a magnet.

Contributed by GRANT JENKINS, JR.



The Extent of a "Static Field" May Be Illustrated by Means of Fine Glass Particles (Powdered Glass) Spread on a Piece of Drawing Paper. A Small Static Machine Will Serve to Supply the Charge.

TO PREVENT BABBITT METAL OR LEAD FROM EXPLODING.

Before pouring the babbitt metal, throw in a piece of resin the size of a walnut, and allow it to melt. This will keep the babbitt

The Home-Treatment of Tuberculosis by High-Frequency Currents

By DR. FREDERICK FINCH STRONG

Lecturer in Electrotherapeutics, Tufts College, Boston

STATISTICS show that one death in every seven is caused by tuberculosis, usually in the form called "Pulmonary tuberculosis," "Tuberculosis of the Lungs" or "Consumption." Sanitary regulations, isolation of cases and hygienic education are rapidly lowering this high death rate, but tuberculosis is still humanity's most terrible scourge.

Thruout the ages "The Great White Plague" has done more to retard human progress than all the wars of the centuries—not excepting the present Armageddon.

Fortunes have been spent in the study of the prevention and cure of this disease; countless fortunes have been made by quacks and mistaken enthusiasts who either claimed or believed themselves to have discovered "A Sure Cure for Consumption." The discovery of tuberculin by Koch was widely heralded as the longed-for panacea, but it proved a failure, and up to the present time no "specific" has been found for the cure of tuberculosis.

The importance of the subject is further emphasized when we reflect that even when it does not manifest as consumption, tuberculosis still does its insidious work in undermining the stamina of the entire race. Dr. A. C. Geyser states that "ninety per cent of all children are infected before their twelfth year, and nearly all bodies that come to autopsy show unmistakable signs of previously existing tubercular lesions." That more people do not develop the disease in its active form is due to the natural curative forces that are always at work in the human body.

Disease germs grow only in a suitable soil or medium; healthy human tissues do not furnish this medium. Only when these tissues are weak, inactive or charged with dead matter do they allow disease germs to multiply in their midst and produce their poisonous secretions.

In a previous article in the March, 1917, *EXPERIMENTER*—"Electricity and Life"—the writer called attention to the existence of the "Vital-force," or "Prana," thru the activity of which all life is maintained. This is absorbed from the food, air and water,

and is probably distributed by a circulating system all its own—a subtle "Etheric Body" which interpenetrates the coarser molecules of the organism and is doubtless formed of imponderable chemical atoms finer than the gas atom and coarser than the electron. Just as modern physicists find it necessary to employ the hypothesis of "The Ether of Space" in order to account for the phenomena of radiant energy, so the most advanced of our physiologists and biologists are assuming the existence of the "Etheric Body" in order to explain the phenomena of life in animal and vegetable bodies.

Probably the great sympathetic nervous system distributes the life-carrying matter of the etheric body in much the same way as the heart and blood vessels transmit food and oxygen to the cells and tissues. The latter circulation depends upon the maintenance of the former, for if pressure is made over certain nerve centers the blood stream is retarded or ceases altogether; pressure on another center stops the breathing mechanism and death from syncope follows. Great discoveries will be made in the immediate future thru the study of the nerve currents and their relation to "the Etheric Body and to "Vital Force."

It is because this vital circulation is fairly active in the majority of persons that so many recover spontaneously from pulmonary tuberculosis. But in cases of weak "vital resistance," where the Prana is not actively distributed to the lung cells, the tubercular germs grow, multiply, secrete poisons and ultimately make the physical body unfit for its human tenant who is forced to move elsewhere!

This lowered cell vitality results from hereditary weakness, improper food, and above all, from insufficient fresh air and out-of-door exercise. We can prevent this hereditary weakness in future generations by following Eugenic principles and exercising the same care that we now use in breeding blooded cattle and horses.

But meanwhile we have in our midst countless thousands of poor sufferers in whom tuberculosis exists in an active form, and the majority of whom face a lingering death scarcely less horrible

than that resulting from the "poison gas" of the war zone. What can we do for these unfortunates? Those of them who can go to the special tuberculosis sanitariums and

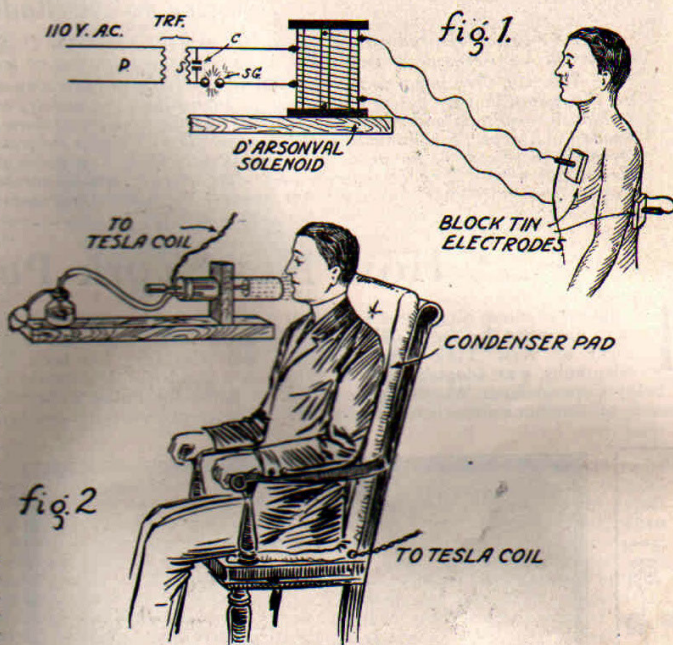
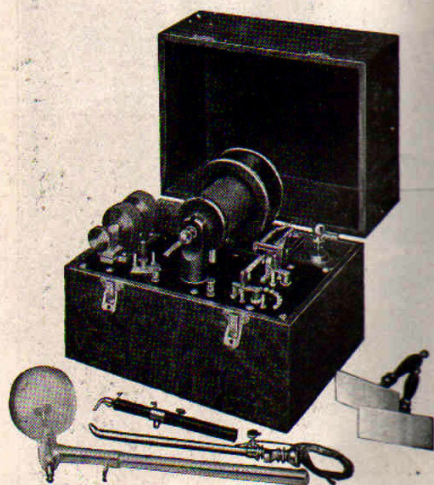


Fig. 1 Shows Treatment of Tuberculosis by "Diathermy." Fig. 2, Treating Tuberculosis by "Ozone Nebula" and Tesla Currents.

have daily treatment under proper surroundings stand a fair chance of recovery, especially when the disease is in the early stages. There are hundreds, however, who cannot go to such institutions.

When we do not use a machine it rusts and falls to pieces; when we do not use an organ or tissue of the human body the life-force and blood supply are diminished and we have a condition where disease germs can find a ready foothold. If certain parts of the lung are not periodically expanded by the inspired air they become "Anaemic" and susceptible to tubercular infection, which afterwards spreads to other parts of the lung. Now if we can find a way of revitalizing these anaemic areas, nature will use the blood and oxygen to start a regenerative process and the bacilli and dead cells will be thrown off in the expectoration. This latter material—the "tubercular sputum"—carries the infection to others; it should always be burned or received in vessels containing antiseptics such as creolin or sulphonaphthol. If this were always done the disease would soon be stamped out.

It is a well known fact that high-frequency currents when past thru the body cause every molecule to vibrate to their particular periodicity, and this vibration produces secondary effects, notably the release of heat in the tissues and the increase of local blood supply. When an acute infection occurs in any part of the



Portable Yet Effective Electrical Apparatus for Diathermy and Tesla Treatment of Tuberculosis.

(Continued on page 718)

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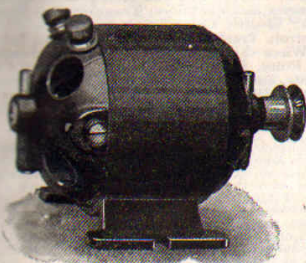
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EXPERIMENTERS: This is the first practical lathe especially designed for all kinds of experimental work. With this lathe you can make almost anything described in this magazine, whether it is in the "Constructor" Department or "How-to-Make-It" Department. Particular attention is called to the fact that cardboard tubes can be wound easily with wire by means of this lathe, and it can easily be driven by means of a sewing machine or by a small electric motor. Excellent for small wood turning, fibre turning, etc. Lathe is made from finest materials. Size seventeen inches over all—center 4 inches. 11 inches center to center. Bed is machined and centers accurately; shipping weight is 13 lbs. price \$4.00 each with order.

Snyder Manufacturing Co., Department C, Toledo, Ohio

THE HOME TREATMENT OF TUBERCULOSIS BY HIGH-FREQUENCY CURRENTS.

(Continued from page 681)

body—for example, in acute bronchitis or "cold in the chest"—we have as prominent symptoms—fever, congestion, cough and expectoration. Most people think that by taking medicine to suppress these symptoms they can cure the disease; hence the use of cough-syrups, sedatives, etc. When the patient recovers under such treatment it is in spite of the medicine rather than because of it, for these symptoms are the very means nature is using to throw off the infection. Extra vital force is being wisely directed to the endangered area—hence the fever, heat, congestion and expectoration. Medical science has been working at the problem of "cure" from the wrong end. Instead of suppressing symptoms we must aid nature to throw off the disease-producing germs and neutralize their poisons. In other words we must assist and promote the process of inflammation. It is because the inflammation is not sufficiently vigorous that many cases of tuberculosis do not recover. The infected areas are usually anaemic to start with and after the infection becomes well established the general blood pressure drops and it is still more difficult to establish the healing inflammatory phenomena. Other germs come in and cause secondary infections which greatly hasten the progress of the disease.

Now the D'Arsonval High-frequency current, when applied to certain tissues of the body, produces all the effects of a natural inflammation—they cause "hyperaemia" or increase of blood to the parts, liberate heat and probably promote the circulation of the vital currents. This method is known as "diathermy" or "thermo-penetration" and has been successfully employed in many hospitals and clinics in treating pulmonary tuberculosis. Dr. Albert Geyser, of New York City, reports over sixty per cent of recoveries in cases so treated at his Clinic at Fordham University; others have reported equally good results, yet it is a fact that the State Boards of Health, the Public Sanitoriums and thousands of lung specialists ignore this important method of combating the "Great White Plague."

For those who can make or procure a High-frequency apparatus, such as the writer described in the December, 1917, issue of the ELECTRICAL EXPERIMENTER, or any other standard therapeutic high-frequency apparatus giving both Tesla and D'Arsonval currents, the successful home treatment of tuberculosis is easily possible. The technique is exceedingly simple—once daily for twenty-five minutes, the patient is given a D'Arsonval treatment—a block-tin electrode attached to a cord connected with each terminal of the solenoid being held or strapped in close contact with the skin of the patient's chest and the corresponding portion of the back (Fig. 1), so that the infected area of the lung lies in the path between the electrodes. The spark is opened until the patient feels a deep penetrating heat in the tissues between the tin electrodes. If the heat becomes uncomfortable the spark gap should be made shorter. All physicians' machines are provided with hot-wire milliamperemeters in the patient's circuit. When the meter is available the current strength can be adjusted so as to begin with 1,000 ma., gradually increasing this to 2,000 ma., by the second or third week of treatment. A home-made machine operated from a one-quarter K. W. wireless transformer will not give more than 1,200 ma., in Diathermy, but this can be made sufficient by increasing the length of the treatment to forty

minutes. Continued daily for months this treatment will bring about recovery in a majority of consumptive patients. It is scarcely necessary to add that proper dietary and hygienic measures should also be employed. Bulletins giving all needed information on these points can be had gratis from any State Board of Health. A physician should be consulted occasionally so that the progress of the case can be intelligently followed.

The use of the "Ozone Nebula" by inhalation is of great value in treating tubercular cases and when it is given in connection with Diathermy the chances of the patient's recovery are materially increased. A simple home-made apparatus for this treatment is made from a Welsbach lamp chimney mounted in a wooden upright as shown in the drawing (Fig. 2); one end of the chimney is open, from which the patient inhales the nebula; the other end is closed with a disc of wood thru which is past a short glass tube three-eighths inch in diameter; a brass rod $\frac{1}{4}$ " by 8" slides thru a hole in the center of the disc. The inner end of the rod carries a small brass disc $1/16$ " by $1\frac{1}{2}$ "; a small insulating rubber handle being attached to the outer end of the rod. A rubber tube connects the small glass tube with a DeVilbiss Oil Nebulizer (procureable for a small sum at any large drug store) containing a small amount of "Pinoleum"—a preparation containing oils of pine and eucalyptus.

In treating, the patient sits on the fiber condenser pad which is connected with one terminal of the Tesla coil; the other Tesla terminal is connected to the brass rod in the chimney which is brought up close to the patient's face until a fine purple effluve passes between him and the brass disc. An assistant now alternately compresses and releases the nebulizer bulb, thereby forcing the vaporized oil across the effluve so that it emerges from the open end of the chimney close to the nose and mouth of the patient. The patient, breathing naturally, inhales the chemical combination which is said to form between the oils and the ozone and nitrous vapors formed in the effluve: these are later released in the lung tissues. The action is antiseptic and also carries oxygen into the infected areas. Clinical tests seem to prove that there is a complicated vitalizing effect obtained by the simultaneous use of the ozone nebula and the Tesla currents.

This method was devised some years ago by the writer and differs from all the Ozone and "Oxylene" systems on the market in the above respect; in other words it is a combination treatment of two well recognized healing agents.

It should be given for only a few minutes at a time, and twice daily. If the vapor is too irritating, reduce the effluve by means of the spark gap or by withdrawing the sliding rod in the chimney.

No possible dangerous effects can follow the intelligent use of the electrotherapeutic methods above described, in the home treatment of tuberculosis, and the beneficial results are very marked.

Those interested in using high-frequency currents for the above purpose should obtain the back numbers of the ELECTRICAL EXPERIMENTER containing the articles "Electricity and Life," and "Treatment of Disease by High-frequency Currents" by the writer.

It is hoped that this article may be the means of enabling many sufferers from tuberculosis to regain their health.

After the disease is once cured its recurrence may be prevented by observing the following rules, which are equally appropriate for anyone who wishes to have more abundant health and life.

1. Breathe deeply plenty of fresh air, night and day.

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.

2. Spend a part of each day walking or working out-of-doors.
3. Make at least one meal each day of nothing but fruit.
4. Make the rest of the diet largely or wholly vegetarian.
5. Never "get sorry for yourself"; get busy and help the other fellow who is worse off than you are.

SHOCK-PROOF SCREW-DRIVER FOR ELECTRICIANS.

The insulated shock-proof screw-driver here illustrated is indispensable to employees of Power Plants, Electric Light, Telephone, Railway and Traction Systems, and all others having to do with live circuits.

The long fibre handle serves a two-fold purpose: first, by being made of a firm, insulating material which will not be damaged if dropt from a height to a hard surface; second, by providing ample room for the worker's hands so that they need not come in contact with the blade. This handle will not be impaired if brought in contact with or immersed in Ammonia, Turpentine or Petroleum, it is claimed.

The blade is hammer forged from crucible steel, and its construction inside the handle is such as to constitute firm holding surfaces.

WOMEN AS RAILWAY EMPLOYEES.

The Interborough Rapid Transit Company and the New York Railways, New York, recently announced that as a war measure the companies would receive applications from women for positions as station employees on the subway and elevated lines and as conductors on the surface lines. Preference will be given to dependent women relatives of employees now in the army and navy, and the pay will be the same as for men. It is not the intention of the company to replace men now employed by women, but only to fill vacancies as they occur. Applicants must be between 21 and 45 years of age. The women conductors will be placed on the pay-as-you-enter cars first.

NEW TOY ELECTRIC MOTOR.

A new toy motor has recently been brought out by a Connecticut concern. This motor is wound particularly for battery use but will operate equally as well used with step-down A.C. transformer direct from house current. It has reverse attachment in the base with special features, and the frame is entirely die-cast. It is said to be the only die-cast motor on the market. The motor is exceptionally powerful for its size owing to the accurate fitting of the parts, particularly the air gap between armature and field. The motor is highly finished and should prove a winner with our young Edisons.

New Toy Electric Motor.

Radium and Radioactive Substances FOR EXPERIMENTERS

Carnotite (Radium Mineral) The American Pitchblende found in Colorado, from which Radium is extracted. A generous piece, enough to conduct experiments, such as affecting photographic plates thru opaque material (similar to X-Ray pictures), first made by Sir W. Crookes and Mme. Curie, is furnished in neat wooden box. Price of one specimen of Carnotite as described above, sent prepaid \$0.25. Sensitive, prepared Photographic film (X-Ray work film) to be used for above experiments furnished for \$0.10 each extra.

Radium—Radioactive Salts, containing one microgram pure Radium. Very powerful! Brilliant white luminescence in the dark! 10 Milligram of this most carefully prepared Radioactive Salts, sealed in glass tube (protected by a metal container), with which every Radium experiment can be conducted, are furnished. Price of one tube of Radium Salts as described, sent prepaid \$1.00. The contents of this tube can be mixed with special sulphides to form real Radium paint. Small bottle of Special Sulphide with liquid adhesive, prepaid \$0.50. Send for one of these preparations today. Stamps or coin accepted.

SIDNEY SPECIALTY CO. 233 S. FULTON ST. NEW YORK CITY



Carnotite



"Don't tell me you never had a chance!"

"Four years ago you and I worked at the same bench. We were both discontented. Remember the noon we saw the International Correspondence Schools' advertisement? That woke me up. I realized that to get ahead I needed special training, and I decided to let the I. C. S. help me. When I marked the coupon I asked you to sign with me. You said, 'Aw, forget it!'"

"I made the most of my opportunity and have been climbing ever since. You had the same chance I had, but you turned it down. No, Jim, you can't expect more money until you've trained yourself to handle bigger work."

There are lots of "Jims" in the world—in stores, factories, offices, everywhere. Are you one of them? Wake up! Every time you see an I. C. S. coupon your chance is staring you in the face. Don't turn it down.

Right now over one hundred thousand men are preparing themselves for bigger jobs and better pay through I. C. S. courses.

You can join them and get in line for promotion. Mark and mail this coupon, and find out how.

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Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

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| <input type="checkbox"/> Electrician | <input type="checkbox"/> SALESMANSHIP |
| <input type="checkbox"/> Electric Wiring | <input type="checkbox"/> ADVERTISING MAN |
| <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Window Trimmer |
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| <input type="checkbox"/> MECHANICAL ENGINEER | <input type="checkbox"/> Stonecrafter and Engraver |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Cert. Pub. Accountant |
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My Inventions

By Nikola Tesla

V. The Magnifying Transmitter

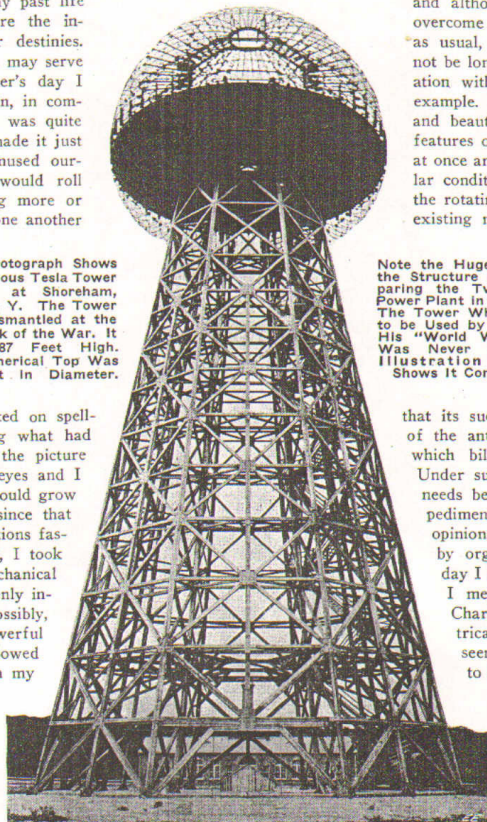
AS I review the events of my past life I realize how subtle are the influences that shape our destinies. An incident of my youth may serve to illustrate. One winter's day I managed to climb a steep mountain, in company with other boys. The snow was quite deep and a warm southerly wind made it just suitable for our purpose. We amused ourselves by throwing balls which would roll down a certain distance, gathering more or less snow, and we tried to outdo one another in this exciting sport.

Suddenly a ball was seen to go beyond the limit, swelling to enormous proportions until it became as big as a house and plunged thundering into the valley below with a force that made the ground tremble. I looked on spell-bound, incapable of understanding what had happened. For weeks afterward the picture of the avalanche was before my eyes and I wondered how anything so small could grow to such an immense size. Ever since that time the magnification of feeble actions fascinated me, and when, years later, I took up the experimental study of mechanical and electrical resonance, I was keenly interested from the very start. Possibly, had it not been for that early powerful impression, I might not have followed up the little spark I obtained with my coil and never developed my best invention, the true history of which I will tell here for the first time.

Scrapping the World's Engines.

"Lionhunters" have often asked me which of my discoveries I prize most. A few technical men, very able in their special departments, but dominated by a pedantic spirit and near-sighted, have asserted that excepting the induction motor I have given to the world little of practical use. This is a grievous mistake. A new idea must not be judged by its immediate results. My alternating system of power transmission came at a psychological moment, as a long-sought answer to pressing industrial questions,

This Photograph Shows the Famous Tesla Tower Erected at Shoreham, L. I., N. Y. The Tower Was Dismantled at the Outbreak of the War. It Was 187 Feet High. The Spherical Top Was 68 Feet in Diameter.



Note the Huge Size of the Structure by Comparing the Two-story Power Plant in the Rear. The Tower Which Was to be Used by Tesla in His "World Wireless," Was Never Finished. Illustration Opposite Shows It Completed.

and altho considerable resistance had to be overcome and opposing interests reconciled, as usual, the commercial introduction could not be long delayed. Now, compare this situation with that confronting my turbine, for example. One should think that so simple and beautiful an invention, possessing many features of an ideal motor, should be adopted at once and, undoubtedly, it would under similar conditions. But the prospective effect of the rotating field was not to render worthless existing machinery; on the contrary, it was

to give it additional value. The system lent itself to new enterprise as well as to improvement of the old. My turbine is an advance of a character entirely different. It is a radical departure in the sense

that its success would mean the abandonment of the antiquated types of prime movers on which billions of dollars have been spent. Under such circumstances the progress must needs be slow and perhaps the greatest impediment is encountered in the prejudicial opinions created in the minds of experts by organized opposition. Only the other day I had a disheartening experience when I met my friend and former assistant, Charles F. Scott, now professor of Electrical Engineering at Yale. I had not seen him for a long time and was glad to have an opportunity for a little chat

at my office. Our conversation naturally enough drifted on my turbine and I became heated to a high degree. "Scott," I exclaimed, carried away by the vision of a glorious future, "my turbine will scrap all the heat-engines in the world." Scott stroked his chin and looked away thoughtfully, as though making a mental calculation. "That will make quite a pile of scrap," he said, and left without another word!

"Aladdin's Lamp".

These and other inventions of mine, however, were nothing more than steps forward in certain directions. In evolving them I simply fol-

IMAGINE a man a century ago, bold enough to design and actually build a huge tower with which to transmit the human voice, music, pictures, press news and even power, thru the earth to any distance whatever without wires! He probably would have been hung or burnt at the stake. So when Tesla built his famous tower on Long Island he was a hundred years ahead of his time. And foolish ridicule by our latter day arm-chair "savants," does not in the least mar Tesla's greatness.

The titanic brain of Tesla has hardly produced a more amazing wonder than this "magnifying transmitter." Contrary to popular belief his tower was not built to radiate Hertzian waves into the ether. Tesla's system sends out thousands of horsepower thru the earth—he has shown experimentally how power can be sent without wires over distances from a central point. Nor is there any mystery about it how he accomplishes the result. His historic U. S. patents and articles describe the method used. Tesla's Magnifying Transmitter is truly a modern lamp of Aladdin.

EDITOR.

lowed the inborn instinct to improve the present devices without
(Continued on page 148)



THIS PHOTOGRAPH OF A MODEL SHOWS HOW THE TESLA TOWER BUILT ON LONG ISLAND, EIGHTEEN YEARS AGO, WOULD HAVE LOOKED COMPLETED. FROM ITS APPEARANCE NOBODY WOULD INFER THAT IT WAS TO BE USED FOR THE GREAT PURPOSES WHICH ARE SET FORTH IN HIS ACCOMPANYING ARTICLE.

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They replace steel phonograph needles!

SONORA Semi-Permanent Silvered Needles are for use on ALL MAKES of steel needle records. They play 50 to 100 times, mellow the tone, are more economical, more convenient, save constant needle changing, and increase the life of the records.



Sonora Semi-Permanent Silvered NEEDLES

Study these microphotographs, Fig. A shows an ordinary steel needle after playing one record. Notice that the point is worn off. Fig. B shows Sonora Needle after playing one record. No wear is perceptible. Fig. C shows Sonora Needle after playing over 50 records. Needle has worn down, but is still in splendid playing condition.

3 Grades: Loud—Medium—Soft
30c per card of 5. In Canada 40c.

FREE

Sample Sonora Needle will be sent FREE on request. Write for it today. Note how many times it plays.

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CAUTION! Beware of similarly constructed needles of inferior quality

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And I will send you a copy of my valuable booklet.

"Hints to Music Loving Owners of Talking Machines"

Tells you how to take care of your machine and records, preserve the life of both, and gives many pointers to improve the tone of your instrument and increase your enjoyment of it. Instructs on the care of the motor, cleaning, speed adjustment, care of the needles—in fact every thing you should know. Send 12c today and the booklet will come by return mail.

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on our new plan! \$10 puts this Young's Superior Phonograph in your home on 30 Days' Trial! Plays all makes of disc records. Cabinet size, 47 ins. high. Rental applies on purchase. \$125 Value for \$62.50. Write for details of greatest phonograph bargain ever offered. Offer limited. Write Today.

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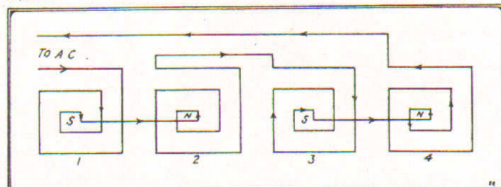
Drive a new 1919 Birch SUPER-FOUR and make good money selling Birch cars to your friends and neighbors. They are fully guaranteed. Prompt shipments. Write quick for full information.

BIRCH MOTOR CARS CHICAGO - ILLINOIS

The Oracle

(Continued from page 146)

as the diagram shows. Those you show in your letter are not correct, for they give like polarity on each pole, which is wrong. We have no data on the starting coil dimensions, but you can arrive at this by experiment, or else by getting in touch with the manufacturers of a similar sized motor.



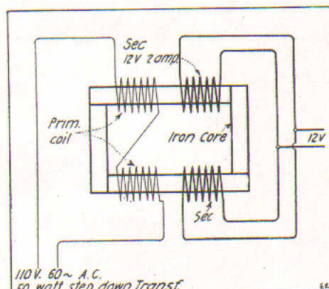
Proper Connection of Poles Composing Starting Winding of Induction Motor.

SPECIAL 110 VOLT TO 12 VOLT A. C. TRANSFORMER.

(1010) August Kling, Mobile, Ala., writes: Q. 1. Asking for data on building a small step-down transformer to give 12 volts at the secondary, which he desires split into two coils. Total output 50 watts.

A. 1. We give herewith data on double wound closed core transformer to step-down 110 volts 60 cycle A. C. to a maximum secondary voltage of 12 volts.

The laminated sheet iron core for this transformer may measure 5 inches wide by 6 inches long, and have a cross-section of 1 inch by $\frac{1}{2}$ inch. At either end of the two longer legs, as the diagram herewith shows, two primary windings may be placed, each of them consisting of 200 turns of No. 18 D. C. C. magnet wire. At either end of the two long legs, the two secondary windings may be placed, as the diagram shows, each of these developing about 12 volts and about 2 amperes, or giving 12 volts and 4 amperes or 50 watts, the total output you request for both secondaries connected in parallel. It is understood that both primaries in this design are to be connected in series on 110 volt 60 cycle A. C. at all times, i.e., whenever the transformer is used. The secondary windings each consist of 45 turns No. 12 B. & S. gage D. C. C. magnet wire, the secondary being wound on either leg beside the primary coil.



110V. 60~ A.C.
50 watt step down Transf.

Details of 110-Volt to 12-Volt A. C. Transformer. Secondary Coils May Be Connected in Parallel or in Series.

With respect to taking off taps on the secondary for different voltages, you can easily divide up the total number of turns on the secondary yourself by means of a small battery voltmeter. You can readily test the potential by experiment. The voltage in any case is directly proportionate to the number of turns in use.

100-WATT, 32 TO 8-VOLT STEP-DOWN TRANSFORMER.

(1011) Claude Carefoot, Pasqua, Sask., Canada, inquires:

Q. 1. For data on step-down transformer to reduce 32 volts to 8 volts, A. C.

A. 1. We do not of course know how many watts you wish the transformer to

carry, but we give you herewith data on a 100-watt transformer. The laminated sheet iron core may be about 8" long by 6" wide and thickness of 1". The core should have a cross-section of 1 square inch. The primary winding, on one leg of the transformer, should consist of 230 turns of No. 11 D.C.C.

magnet wire. The secondary winding should have 58 turns of No. 5 D.C.C. magnet wire.

My Inventions By Nikola Tesla

(Continued from page 112)

any special thought of our far more imperative necessities. The "Magnifying Transmitter" was the product of labors extending through years, having for their chief object the solution of problems which are infinitely more important to mankind than mere industrial development.

If my memory serves me right, it was in November, 1890, that I performed a laboratory experiment which was one of the most extraordinary and spectacular ever recorded in the annals of science. In investigating the behaviour of high frequency currents I had satisfied myself that an electric field of sufficient intensity could be produced in a room to light up electrodeless vacuum tubes. Accordingly, a transformer was built to test the theory and the first trial proved a marvelous success. It is difficult to appreciate what those strange phenomena meant at that time. We crave for new sensations but soon become indifferent to them. The wonders of yesterday are today common occurrences. When my tubes were first publicly exhibited they were viewed with amazement impossible to describe. From all parts of the world I received urgent invitations and numerous honors and other flattering inducements were offered to me, which I declined.

In Faraday's Chair

But in 1892 the demands became irresistible and I went to London where I delivered a lecture before the Institution of Electrical Engineers. It had been my intention to leave immediately for Paris in compliance with a similar obligation, but Sir James Dewar insisted on my appearing before the Royal Institution. I was a man of firm resolve but succumbed easily to the forceful arguments of the great Scotchman. He pushed me into a chair and poured out half a glass of a wonderful brown fluid which sparkled in all sorts of iridescent colors and tasted like nectar. "Now," said he, "you are sitting in Faraday's chair and you are enjoying whiskey he used to drink." In both aspects it was an enviable experience. The next evening I gave a demonstration before that Institution, at the termination of which Lord Rayleigh addressed the audience and his generous words gave me the first start in these endeavors. I fled from London and later from Paris to escape favors

(Continued on page 173)

My Inventions

By Nikola Tesla

(Continued from page 148)

showered upon me, and journeyed to my home where I passed through a most painful ordeal and illness. Upon regaining my health I began to formulate plans for the resumption of work in America. Up to that time I never realized that I possessed any particular gift of discovery but Lord Rayleigh, whom I always considered as an ideal man of science, had said so and if that was the case I felt that I should concentrate on some big idea.

Nature's Trigger.

One day, as I was roaming in the mountains, I sought shelter from an approaching storm. The sky became overhung with heavy clouds but somehow the rain was delayed until, all of a sudden, there was a lightning flash and a few moments after a deluge. This observation set me thinking. It was manifest that the two phenomena were closely related, as cause and effect, and a little reflection led me to the conclusion that the electrical energy involved in the precipitation of the water was inconsiderable, the function of lightning being much like that of a sensitive trigger. Here was a stupendous possibility of achievement. If we could produce electric effects of the required quality, this whole planet and the conditions of existence on it could be transformed. The sun raises the water of the oceans and winds drive it to distant regions where it remains in a state of most delicate balance. If it were in our power to upset it when and wherever desired, this mighty life-sustaining stream could be at will controlled. We could irrigate arid deserts, create lakes and rivers and provide motive power in unlimited amounts. This would be the most efficient way of harnessing the sun to the uses of man. The consummation depended on our ability to develop electric forces of the order of those in nature. It seemed a hopeless undertaking, but I made up my mind to try it and immediately, on my return to the United States, in the summer of 1892, work was begun which was to me all the more attractive, because a means of the same kind was necessary for the successful transmission of energy without wires.

Four Million Volts.

The first gratifying result was obtained in the spring of the succeeding year when I reached tensions of about 1,000,000 volts with my conical coil. That was not much in the light of the present art, but it was then considered a feat. Steady progress was made until the destruction of my laboratory by fire in 1895, as may be judged from an article by T. C. Martin which appeared in the April number of the *Century Magazine*. This calamity set me back in many ways and most of that year had to be devoted to planning and reconstruction. However, as soon as circumstances permitted, I returned to the task. Although I knew that higher electro-motive forces were attainable with apparatus of larger dimensions, I had an instinctive perception that the object could be accomplished by the proper design of a comparatively small and compact transformer. In carrying on tests with a secondary in the form of a flat spiral, as illustrated in my patents, the absence of streamers surprised me, and it was not long before I discovered that this was due to the position of the turns and their mutual action. Profiting from this observation I resorted to the use of a high tension conductor with turns of considerable diameter sufficiently separated to keep down the distributed capacity, while at the

(Continued on page 176)



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They enable you to "hear with both ears" because Brandes diaphragms are perfectly matched for tone, and both receivers are perfectly tuned together. Handsome, well made, fine quality.

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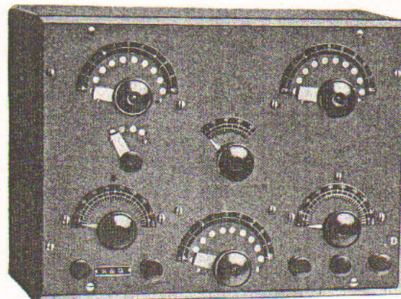
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The Universal Radio Manufacturing Corporation has taken over the business previously conducted by the Mignon Wireless Corporation and is prepared to furnish all of the Mignon system instruments, built according to the original Mignon specifications. In addition to these, the Corporation has recently perfected a series of new type instruments which for efficient work and real service have never been equalled.

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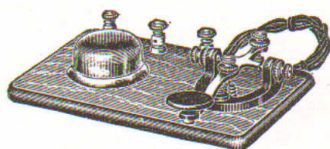
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MESCO WIRELESS PRACTICE SET



The Practice Set comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal Dry Battery, and four feet of green silk covered flexible cord.

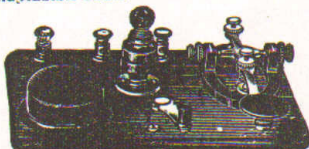
The key and buzzer are mounted on a highly finished wood base, and three nickel plated binding posts are so connected that the set may be used for five different purposes.

List No. 342 Telephone Practice Set, with Battery and Cord \$3.24
Weights 4 lbs. packed.
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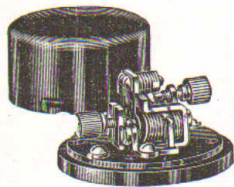
MESCO Combination Practice Set for Learning the Morse and Continental Visual and Audible Codes

This outfit is the only reliable instrument which will enable students to become proficient operators in the U. S. Naval Service, because it is equipped with a buzzer and miniature lamp enabling the user to master both the visual and audible signals quickly.

List No. 52—Practice Set with Red Seal Battery and Cord \$4.05
Weights 4 lbs. packed. Price does not include postage.



MESCO RADIO BUZZER



This buzzer maintains a constant note and is recommended as an exciter for checking wavemeters where pure note and ample energy are required.

It consists of practically a closed circuit field of low reluctance, having a steel armature to which is riveted a strap supporting a movable contact. The armature tension is adjustable by means of a screw with a milled head large enough to be easily and permanently adjusted with the fingers. The stationary contact is adjusted by means of a similar screw. The magnet coils are connected in series with a total D. C. resistance of 3.9 ohms. Shunted across these coils is a resistance having a D. C. value of 3 ohms. This shunt eliminates all sparking such as occurs at the break on ordinary radio buzzers and the energy saved thereby is transferred into any oscillating circuit connected to it, the result being that this buzzer as constructed radiates five times more energy than any other existing type. All connecting wires liable to be broken are eliminated. Contacts are of genuine platinum, which is essential in order to maintain a constant note. The parts are mounted on a Condensate base to insure constancy in operation.

Diameter 2 in., height 1 1/4 in. The cap is attached to the base by a bayonet joint.
List No. 55 Mesco Radio Buzzer \$2.05

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Cambridge, Mass.

My Inventions

By Nikola Tesla

(Continued from page 173)

same time preventing undue accumulation of the charge at any point. The application of this principle enabled me to produce pressures of 4,000,000 volts, which was about the limit obtainable in my new laboratory at Houston Street, as the discharges extended through a distance of 16 feet. A photograph of this transmitter was published in the *Electrical Review* of November, 1898. In order to advance further along this line I had to go into the open, and in the spring of 1899, having completed preparations for the erection of a wireless plant, I went to Colorado where I remained for more than one year. Here I introduced other improvements and refinements which made it possible to generate currents of any tension that may be desired. Those who are interested will find some information in regard to the experiments I conducted there in my article, "The Problem of Increasing Human Energy," in the *Century Magazine* of June, 1900, to which I have referred on a previous occasion.

The Magnifying Transmitter.

I have been asked by the ELECTRICAL EXPERIMENTER to be quite explicit on this subject so that my young friends among the readers of the magazine will clearly understand the construction and operation of my "Magnifying Transmitter" and the purposes for which it is intended. Well, then, in the first place, it is a resonant transformer with a secondary in which the parts, charged to a high potential, are of considerable area and arranged in space along ideal enveloping surfaces of very large radii of curvature, and at proper distances from one another thereby insuring a small electric surface density everywhere so that no leak can occur even if the conductor is bare. It is suitable for any frequency, from a few to many thousands of cycles per second, and can be used in the production of currents of tremendous volume and moderate pressure, or of smaller amperage and immense electro-motive force. The maximum electric tension is merely dependent on the curvature of the surfaces on which the charged elements are situated and the area of the latter.

100 Million Volts Possible.

Judging from my past experience, as much as 100,000,000 volts are perfectly practicable. On the other hand currents of many thousands of amperes may be obtained in the antenna. A plant of but very moderate dimensions is required for such performances. Theoretically, a terminal of less than 90 feet in diameter is sufficient to develop an electro-motive force of that magnitude while for antenna currents of from 2,000-4,000 amperes at the usual frequencies it need not be larger than 30 feet in diameter.

In a more restricted meaning this wireless transmitter is one in which the Hertz-wave radiation is an entirely negligible quantity as compared with the whole energy, under which condition the damping factor is extremely small and an enormous charge is stored in the elevated capacity. Such a circuit may then be excited with impulses of any kind, even of low frequency and it will yield sinusoidal and continuous oscillations like those of an alternator.

Taken in the narrowest significance of the term, however, it is a resonant transformer which, besides possessing these qualities, is accurately proportioned to fit the globe and its electrical constants and properties, by virtue of which design it becomes highly efficient and effective in the

wireless transmission of energy. Distance is then absolutely eliminated, there being no diminution in the intensity of the transmitted impulses. It is even possible to make the actions increase with the distance from the plant according to an exact mathematical law.

This invention was one of a number comprised in my "World-System" of wireless transmission which I undertook to commercialize on my return to New York in 1900. As to the immediate purposes of my enterprise, they were clearly outlined in a technical statement of that period from which I quote:

"The 'World-System' has resulted from a combination of several original discoveries made by the inventor in the course of long continued research and experimentation. It makes possible not only the instantaneous and precise wireless transmission of any kind of signals, messages or characters, to all parts of the world, but also the inter-connection of the existing telegraph, telephone, and other signal stations without any change in their present equipment. By its means, for instance, a telephone subscriber here may call up and talk to any other subscriber on the Globe. An inexpensive receiver, not bigger than a watch, will enable him to listen anywhere, on land or sea, to a speech delivered or music played in some other place, however distant. These examples are cited merely to give an idea of the possibilities of this great scientific advance, which annihilates distance and makes that perfect natural conductor, the Earth, available for all the innumerable purposes which human ingenuity has found for a line-wire. One far-reaching result of this is that any device capable of being operated thru one or more wires (at a distance obviously restricted) can likewise be actuated, without artificial conductors and with the same facility and accuracy, at distances to which there are no limits other than those imposed by the physical dimensions of the Globe. Thus, not only will entirely new fields for commercial exploitation be opened up by this ideal method of transmission but the old ones vastly extended.

"The 'World-System' is based on the application of the following important inventions and discoveries:

"1. The 'Tesla Transformer.' This apparatus is in the production of electrical vibrations as revolutionary as gunpowder was in warfare. Currents many times stronger than any ever generated in the usual ways, and sparks over one hundred feet long, have been produced by the inventor with an instrument of this kind.

"2. The 'Magnifying Transmitter.' This is Tesla's best invention—a peculiar transformer specially adapted to excite the Earth, which is in the transmission of electrical energy what the telescope is in astronomical observation. By the use of this marvelous device he has already set up electrical movements of greater intensity than those of lightning and passed a current, sufficient to light more than two hundred incandescent lamps, around the Globe.

"3. The 'Tesla Wireless System.' This system comprises a number of improvements and is the only means known for transmitting economically electrical energy to a distance without wires. Careful tests and measurements in connection with an experimental station of great activity, erected by the inventor in Colorado, have demonstrated that power in any desired amount can be conveyed, clear across the Globe if necessary, with a loss not exceeding a few per cent.

"4. The 'Art of Individualization.' This invention of Tesla is to primitive 'tuning' what refined language is to unarticulated expression. It makes possible the transmission of signals or messages absolutely secret and exclusive both in the active and passive aspect, that is, non-interfering as well as non-interferable. Each signal is like an individual of unmistakable identity and there is virtually no limit to the number of stations or instruments which can be simultaneously operated without the slightest mutual disturbance.

"5. The 'terrestrial Stationary Waves.' This wonderful discovery, popularly explained, means that the Earth is responsive to electrical vibrations of definite pitch just as a tuning fork to certain waves of sound. These particular electrical vibrations, capable of powerfully exciting the Globe, lend themselves to innumerable uses of great importance commercially and in many other respects.

"The first 'World-System' power plant can be put in operation in nine months. With this power plant it will be practicable to attain electrical activities up to ten million horsepower and it is designed to serve for as many technical achievements as are possible without due expense. Among these the following may be mentioned:

"(1) The inter-connection of the existing telegraph exchanges or offices all over the world;

"(2) The establishment of a secret and non-interferable government telegraph service;

"(3) The inter-connection of all the present telephone exchanges or offices on the Globe;

"(4) The universal distribution of general news, by telegraph or telephone, in connection with the Press;

"(5) The establishment of such a 'World-System' of intelligence transmission for exclusive private use;

"(6) The inter-connection and operation of all stock tickers of the world:

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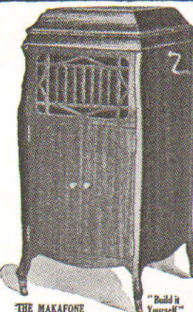
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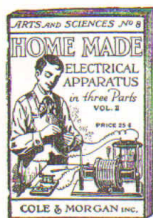
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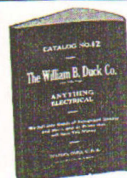
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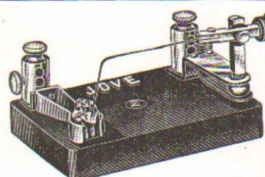
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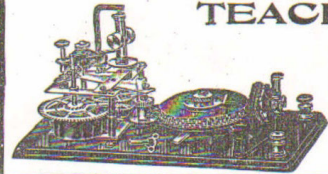
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"(7) The establishment of a 'World-System' of musical distribution, etc.;

"(8) The universal registration of time by cheap clocks indicating the hour with astronomical precision and requiring no attention whatever;

"(9) The world transmission of typed or hand-written characters, letters, checks, etc.;

"(10) The establishment of a universal marine service enabling the navigators of all ships to steer perfectly without compass, to determine the exact location, hour and speed, to prevent collisions and disasters, etc.;

"(11) The inauguration of a system of world-printing on land and sea;

"(12) The world reproduction of photographic pictures and all kinds of drawings or records."

I also proposed to make demonstrations in the wireless transmission of power on a small scale but sufficient to carry conviction. Besides these I referred to other and incomparably more important applications of my discoveries which will be disclosed at some future date.

A plant was built on Long Island with a tower 187 feet high, having a spherical terminal about 68 feet in diameter. These dimensions were adequate for the transmission of virtually any amount of energy. Originally only from 200 to 300 K.W. were provided but I intended to employ later several thousand horsepower. The transmitter was to emit a wave-complex of special characteristics and I had devised a unique method of telephonic control of any amount of energy.

The tower was destroyed two years ago but my projects are being developed and another one, improved in some features, will be constructed. On this occasion I would contradict the widely circulated report that the structure was demolished by the Government which owing to war conditions, might have created prejudice in the minds of those who may not know that the papers, which thirty years ago conferred upon me the honor of American citizenship, are always kept in a safe, while my orders, diplomas, degrees, gold medals and other distinctions are packed away in old trunks. If this report had a foundation I would have been refunded a large sum of money which I expended in the construction of the tower. On the contrary it was in the interest of the Government to preserve it, particularly as it would have made possible—to mention just one valuable result—the location of a submarine in any part of the world. My plant, services, and all my improvements have always been at the disposal of the officials and ever since the outbreak of the European conflict I have been working at a sacrifice on several inventions of mine relating to aerial navigation, ship propulsion and wireless transmission which are of the greatest importance to the country. Those who are well informed know that my ideas have revolutionized the industries of the United States and I am not aware that there lives an inventor who has been, in this respect, as fortunate as myself especially as regards the use of his improvements in the war. I have refrained from publicly expressing myself on this subject before as it seemed improper to dwell on personal matters while all the world was in dire trouble. I would add further, in view of various rumors which have reached me, that Mr. J. Pierpont Morgan did not interest himself with me in a business way but in the same large spirit in which he has assisted many other pioneers. He carried out his generous promise to the letter and it would have been most unreasonable to expect from him anything more. He had the highest regard for my attainments and gave me every evidence of his complete faith in my ability to ultimately achieve what I had set out to do. I am unwilling to accord to some small-minded and jealous individuals the satisfaction of having thwarted my efforts. These men are to me nothing more than microbes of a nasty disease. My project was retarded by laws of nature. The world was not prepared for it. It was too far ahead of time. But the same laws will prevail in the end and make it a triumphal success.

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The First Practical A. C. Dynamo

THE illustration shows a photograph of a dynamo which is among the earliest built by Professor Elihu Thomson. It is really the machine which called attention of the gentleman who first, in Philadelphia in 1879, started to develop a business of arc lighting, based on the inventions of Thomson and Houston. The machine itself was constructed in its entirety by Professor Thomson. He made the patterns, had them cast, built the frame, made the field bobbins and wound them, and also wound the armature, made the connections thereto and all the machine parts of the machine itself. It weighed about 350 pounds and the base of the machine was bolted together and made of pieces of plank. It will be noted

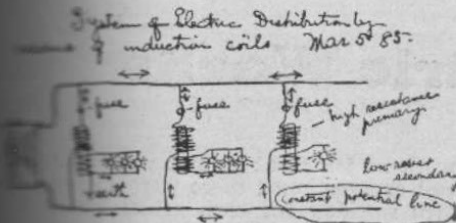
that the field castings consist of two yoke pieces at the end, to which are bolted the horizontal field cores, four of which were used to save making a more complicated pattern. The two upper and the two lower field poles which meet in the center, are tied together by a piece of hard wood bolted to them. For lack of machine facilities, there is no boring or turning of the field or armature and the end yoke pieces were fitted to the cores by chipping, no planer being available.

One of the curious mechanical features is the cast-iron boxes receiving the shaft, which, strange to say, worked without heating during the running of the machine.

The machine was started in the fall of 1878 and by the end of that year was ready

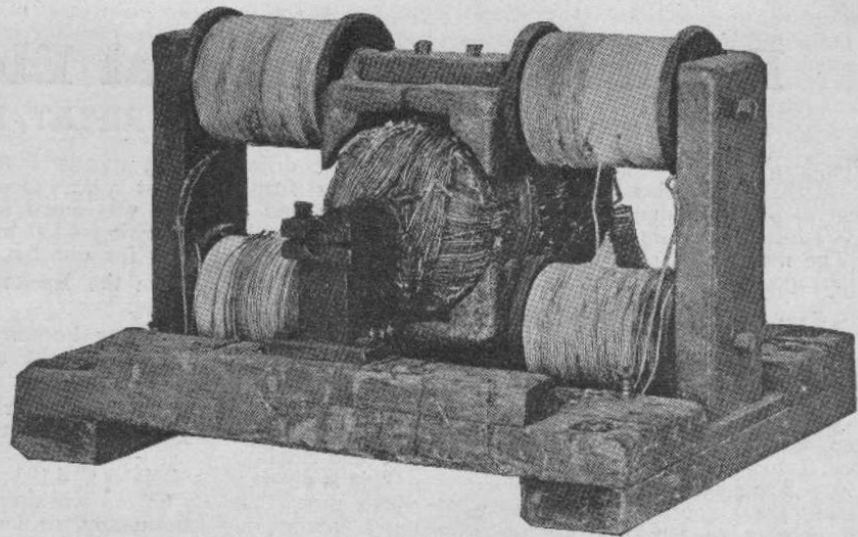
to operate. In some respects it was unique. It really was a machine which could be coupled so as to give varying voltage and current. There were four field coils, which could be connected in series or in series-multiple, or the whole of them parallel, so that the virtual section of the wire was increased one, two and four. The same construction was adopted in the armature winding, there being in each of the two coils (which are clearly shown crossing each other at right angles) four separate wires which could be connected by a connection board, which is at the other end of the armature from that shown, so as to use wires in series, or in series-multiple, or in multiple, and so varying the voltage

(Continued on page 908)



The idea is to have a constant potential source current (alternating) dynamo, feeding lines which remain at constant potential. Secondary lines are connected and induce currents into primaries of relatively high resistance. The secondaries are low resistance and feed the light. Advantage is in saving of copper in mains and also in insulation. The potential of the mains being quite high from 1000 to 2000 volts. The fuses save the primary in case secondary is short circuited.

Accordingly, Indeed, Is This Original Handwritten Memorandum From the Notebook of Prof. Elihu Thomson, Made in the Days When Electric Arc-Lighting Was in Its Infancy.



The Photo Above Shows One of the Very First Practical Alternating Current Arc-Lighting Dynamos Built by Prof. Thomson. He Made the Patterns, Had Them Cast, Built the Frame, Wound the Field Bobbins, and Demonstrated the Machine Successfully to the First Staff of Electric-Lighting Critics, Which Started the Present Industry on Its Way.



THIS PHOTOGRAPH OF A MODEL SHOWS HOW THE TESLA TOWER BUILT ON LONG ISLAND, EIGHTEEN YEARS AGO, WOULD HAVE LOOKED COMPLETED, FROM ITS APPEARANCE NOBODY WOULD INFER THAT IT WAS TO BE USED FOR THE GREAT PURPOSES WHICH ARE SET FORTH IN HIS ACCOMPANYING ARTICLE.

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My Inventions

By Nikola Tesla

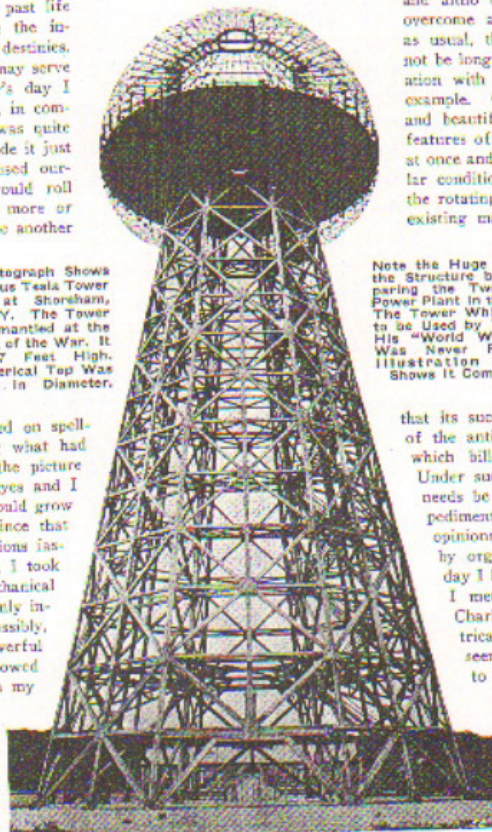
V. The Magnifying Transmitter

AS I review the events of my past life I realize how subtle are the influences that shape our destinies. An incident of my youth may serve to illustrate. One winter's day I managed to climb a steep mountain, in company with other boys. The snow was quite deep and a warm southerly wind made it just suitable for our purpose. We amused ourselves by throwing balls which would roll down a certain distance, gathering more or less snow, and we tried to outdo one another in this exciting sport. Suddenly a ball was seen to go beyond the limit, swelling to enormous proportions until it became as big as a house and plunged thundering into the valley below with a force that made the ground tremble. I looked on spell-bound, incapable of understanding what had happened. For weeks afterward the picture of the avalanche was before my eyes and I wondered how anything so small could grow to such an immense size. Ever since that time the magnification of feeble actions fascinated me, and when, years later, I took up the experimental study of mechanical and electrical resonance, I was keenly interested from the very start. Possibly, had it not been for that early powerful impression, I might not have followed up the little spark I obtained with my coil and never developed my best invention, the true history of which I will tell here for the first time.

Scrapping the World's Engines.

"Lionhunters" have often asked me which of coveries I prize most, a few technical men, very able in their special departments, but dominated by a pedantic spirit and near-sighted, have asserted that excepting the induction motor I have given to the world little of practical use. This is a grievous mistake. A new idea must not be judged by its immediate results. My alternating system of power transmission came at a psychological moment, as a long-sought answer to pressing industrial questions,

This Photograph Shows the Famous Tesla Tower Erected at Shoreham, L. I., N. Y. The Tower Was Dismantled at the Outbreak of the War. It Was 157 Feet High. The Spherical Top Was 68 Feet in Diameter.



Note the Huge Size of the Structure by Comparing the Two-story Power Plant in the Rear. The Tower Which Was to be Used by Tesla in His "World Wireless," Was Never Finished. Illustration Opposite Shows It Completed.

and altho considerable resistance had to be overcome and opposing interests reconciled, as usual, the commercial introduction could not be long delayed. Now, compare this situation with that confronting my turbine, for example. One should think that so simple and beautiful an invention, possessing many features of an ideal motor, should be adopted at once and, undoubtedly, it would under similar conditions. But the prospective effect of the rotating field was not to render worthless existing machinery; on the contrary, it was to give it additional value. The system lent itself to new enterprise as well as to improvement of the old. My turbine is an advance of a character entirely different. It is a radical departure in the sense

that its success would mean the abandonment of the antiquated types of prime movers on which billions of dollars have been spent. Under such circumstances the progress must needs be slow and perhaps the greatest impediment is encountered in the prejudicial opinions created in the minds of experts by organized opposition. Only the other day I had a disheartening experience when I met my friend and former assistant, Charles F. Scott, now professor of Electrical Engineering at Yale. I had not seen him for a long time and was glad to have an opportunity for a little chat at my office. Our conversation naturally enough drifted on my turbine and I became heated to a high degree. "Scott," I exclaimed, carried away by the vision of a glorious future, "my turbine will scrap all the heat-engines in the world." Scott stroked his chin and looked away thoughtfully, as though making a mental calculation. "That will make quite a pile of scrap," he said, and left without another word!

"Aladdin's Lamp".

These and other inventions of mine, however, were nothing more than steps forward in certain directions. In evolving them I simply followed the inborn instinct to improve the present devices without

IMAGINE a man a century ago, bold enough to design and actually build a huge tower with which to transmit the human voice, music, pictures, press news and even power, thru the earth to any distance whatever without wires! He probably would have been hung or burnt at the stake. So when Tesla built his famous tower on Long Island he was a hundred years ahead of his time. And foolish ridicule by our latter day arm-chair "savants," does not in the least mar Tesla's greatness.

The titanic brain of Tesla has hardly produced a more amazing wonder than this "magnifying transmitter." Contrary to popular belief his tower was not built to radiate Hertzian waves into the ether. Tesla's system sends out thousands of horsepower thru the earth—he has shown experimentally how power can be sent without wires over distances from a central point. Nor is there any mystery about it how he accomplishes the result. His historic U. S. patents and articles describe the method used. Tesla's Magnifying Transmitter is truly a modern lamp of Aladdin.

EDITOR.

ment, as a long-sought answer to pressing industrial questions,

lowed the inborn instinct to improve the present devices without
(Continued on page 148)

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Mr. Tesla's articles started in our February issue